

Appendix F

Temporal Variation in Flow in the Mainstem and Tributaries of the San Joaquin River 2005-2007

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Introduction

The Environmental Engineering Research Program (EERP) at the University of the Pacific (UOP) is the lead scientific agency on several water quality and ecosystem restoration projects focused on understanding and improving water quality in the San Joaquin River (SJR). EERP projects include the development of a mass balance on phytoplankton and oxygen demanding materials in the SJR, evaluation of organic carbon sources and fate in the SJR, studies of wetland ecosystems, and studies examining the impact of current agricultural best management practices (BMPs) on water quality. For all of these projects, water quality and water flow must be measured at numerous locations throughout the watershed.

The objective of this report is to document all flow data collected by EERP between 2005-2007 at sites in the SJR Valley. Water quality data and flow were collected over a three year period (2005-2007). Data was then graphed by site for each year and for all three years together. Flow data is used to determine load of water quality parameters at the EERP sample sites.

Methods

Flow and water quality data were monitored at 53 sites in the San Joaquin River Valley (Table 1). At site data were averaged by day, where available, and then graphed over the three year period in Grapher 6 (Golden Software Inc., Golden, CO). Flow was plotted against all three years in one graph and day of year to produce three separate graphs, one for each year. If a station did not have flow available for a particular year the graph was labeled with data not available. Data for each of the flow stations were collected from a number of different sources (Table 1). Most of the flow data used in this report was preliminary data because data collected from the website for the California Data Exchange Center (CDEC) was tagged as provisional data and subject to change. CDEC has to date, not made available any data with verifiable accuracy nor offered any quality assurance data for what they are reporting.

Data was measured and recorded every fifteen minutes or hourly at the majority of flow stations while a few sites only reported daily averages, or in the case of DO-43 El Solyo Water District Diversion (Figures 71-72) and DO-40 Patterson Irrigation District diversion (Figures 65-66) monthly averages. All of the fifteen minute and hourly data was averaged by day, potentially washing out the effects of any daily variation at the site. Dataloggers stored data from the sensors that could be accessed through a telemetry system or manually downloaded using a PCMCIA flash card from the logger. Most stations were equipped with a telemetry system such as GOES or SCADA systems. The GOES telemetry system reported data directly to a DOMSAT station operated by the Department of Water Resources California Data Exchange Center, which could then be downloaded from the CDEC website. SCADA systems reported data directly through e-mail to the persons responsible for the site's data collection.

Existing structures and channel morphology determined what equipment was used to measure flow at a given site. Where a weir was present, the stage value along with the weir equation was used to compute discharge. Pressure transducers, float and shaft encoders, Stevens chart recorders, and Design Analysis H355 Smartgas bubbler systems were all used

to measure stage (Table 2). Some sites with culverts and open channels were installed with Doppler units to measure the discharge, such as a SONTEK, MACE, or STARFLOW (Table 2). Continuous monitoring sites that lacked a structure relied on a stage to discharge relationship from a rating curve to determine flow. These sites could then utilize a Design analysis H355 Smartgas bubbler system or some other stage measuring equipment to determine discharge. Quality assurance was ensured at EERP managed sites with monthly flow ratings wherever possible to account for relational drift due to changing stream bed morphologies.

Results and Discussion

Data were collected and compiled for all sites. Summary statistics by annual year for flow are presented in Tables 3, 4, and 5 for 2005, 2006, and 2007, respectively. There are a total of 106 figures (Figures 1-106) representing data available for 53 sites, plotted data are presented in order of station number with the exception of the main stem San Joaquin River sites which are presented from most downstream to most upstream (Table 1). Each site is plotted on four plots consisting of one plot for each year (2005-2007) and a combined plot showing all three years on one axis. All the available data for a site is plotted and any gaps in the data are shown on the plot.

Analyzing the plots we can make observations on spatial and temporal trends in the flow data for each site as well as the San Joaquin River Valley system as a whole. Comparing main stem sites for the San Joaquin River (Figures 1-20), a difference in water year types is noticed (Table 6), with 2005 and 2006 being wet years and 2007 being a dry year (Letain and Stringfellow, 2007). Looking at the scales of the plots there is a significant difference between 2006 and 2007 and little difference between 2005 and 2006. Comparing the San Joaquin River and the major tributaries to the agricultural drains shows the flows for the agricultural drains were independent of water year type. In 2007 the average annual SJR diversions by three of the four main west-side irrigation districts increased slightly (Tables 3-5) due to an earlier start to the irrigation season rather than greater flows during the season as can be seen in the plotted data (Figures 65-72). East-side sites DO-22 through DO-30 (Figures 35-52) also showed earlier irrigation delivery flows for 2007 than for the especially wet spring and early summer of 2006 when there was widespread flooding throughout the valley. 2005 was also a wetter than average year (Table 6) but eastside irrigation deliveries for that year were more similar to 2007 than 2006. State water deliveries via DO-47, the Delta Mendota Canal, were inversely proportional to the water supply index for 2005 and 2006 and probably 2007 when that data becomes available.

The San Joaquin River system is highly variable with statistically significant variations in flow between seasons and between years (Letain and Stringfellow, 2007). There are numerous pumps, siphons, drains, and tributaries along the river, both removing and returning water to the system. Despite all of the variation, EERP and various other agencies were able to collect high quality flow data accurately representing the San Joaquin River in real-time. In general, the flow stations in the San Joaquin River watershed reported high quality data for 2005-2007. Occasionally equipment used at the flow stations malfunctioned or reported low quality data resulting in data gaps. DO-01 SJR at Channel Point uses data from the closest flow monitoring station located in the San Joaquin River Deep Water Shipping Channel at Rough and Ready Island. Flow data did not become available through the CDEC website until 2007. DO-04 SJR at Mossdale and DO-06 SJR at Maze Blvd. data

became available through CDEC starting in 2006. DO-61 Deadmans Slough was not reported for 2005 because of low quality data from beaver activity affecting measurements. The data missing for 2005 and the gaps in 2006 at DO-31 New Jerusalem Drain were due to a faulty Starflow Doppler unit and leaky bubbler line at the site. The station at DO-28 TID Westport Drain was washed out prior to 2005 and was not reporting data until 2007. The stations at DO-20 Los Banos Creek and DO-57 Ramona Lake at Levee were washed out in the floods of 2006 and could not report data until late 2006 for DO-20 Los Banos Creek and mid 2007 for DO-57 Ramona Lake at Levee. DO-35 Westley Wasteway was unreliable due to original configuration and blockage from debris in the water until the station was upgraded in 2006. DO-36 Del Puerto Creek had a leak in the bubbler line in 2006 and a clogged bubbler line in 2007 resulting in gaps in the flow data for those years. DO-38 Marshall Road Drain was missing data from the beginning of 2006 as a result of a logger malfunction. Data was not reported for the end of 2007 for DO-20 Los Banos Creek, DO-45 Volta Wasteway, DO-46 Mud Slough at Gun Club Road, DO-53 Salt Slough at Wolfsen, DO-60 Moffit 1 South, DO-61 Deadmans Slough, DO-62 Mallard Slough, DO-63 Inlet C Canal, and DO-68 S-Lake Drain due to limitations on the agencies managing those stations.

Conclusions

Flow was reported for most sites for the three year period (2005-2007) with the record becoming more complete as monitoring stations and equipment are added over time by EERP and other agencies. The reported data was high quality despite the problems with occasional equipment failures and damages to the flow stations. Collected data covered all of the significant tributaries and drains into the study area on the San Joaquin River. The temporal plots show significant differences in water year types and between agriculture drains and other tributaries.

Most equipment failures were identified and corrected as quickly as possible and upgrades at some sites significantly improved data reliability. All data has been checked for accuracy to whatever extent possible but caution must still be exercised when comparing average annual flow values. Because of the great seasonal variability (Letain and Stringfellow, 2007) a small gap in data due to a temporary measurement failure can skew the annual average. This is why the data are presented graphically in addition to the simple tabulated averages. The goals of this report were met with the continuous monitoring of flow at the relevant EERP sample sites.

References

- Hanlon, J., Quinn, N., Linneman, C., Niemi, M., Larson, K., Graham, J., 2008. Up-Stream DO TMDL Project Task: 5 Description of Flow and Water Quality Monitoring Upgrades and Photo Documentation. Environmental Engineering Research Program, Stockton, CA.
- Letain, T., Stringfellow, W., 2007. Statistical Comparison of Water Flow Rates for San Joaquin Valley Drainages and the San Joaquin 60-20-20 Water Supply Index for 2000 – 2006. Environmental Engineering Research Program, Stockton, CA.

Table 1: List of flow stations and data sources.

DO Site	Station Name	Latitude	Longitude	Station Owner	Data Contact/Source
1	SJR at Channel Point	37.950	-121.337	DWR	CDEC/DWR
84	SJR at Garwood Bridge (Hwy 4)	37.836	-121.311	DWR	CDEC/Joe Tapia
3	SJR at Old River	37.819	-121.324	DWR	CDEC/Joe Tapia
4	SJR at Mossdale	37.787	-121.308	DWR	CDEC/Joe Tapia
5	SJR at Vernalis-McCune Station	37.679	-121.265	DWR/USGS	CDEC/USGS Sacramento
6	SJR at Maze	37.641	-121.229	DWR	CDEC/Joe Tapia
7	SJR at Patterson	37.494	-121.081	DWR	CDEC/Joe Tapia
8	SJR at Crows Landing	37.432	-121.012	USGS	CDEC/USGS Sacramento
9	SJR at Fremont Ford	37.310	-120.931	USGS	CDEC/USGS Sacramento
10	SJR at Lander Avenue	37.294	-120.851	DWR	CDEC/Joe Tapia
13	Stanislaus River at Ripon	37.731	-121.108	USGS	CDEC/USGS Sacramento
15	Tuolumne River at Modesto	37.627	-120.987	USGS	CDEC/USGS Sacramento
17	Merced River near Stevinson	37.387	-120.794	DWR	CDEC/Joe Tapia
18	Mud Slough near Gustine	37.263	-120.906	USGS	CDEC/USGS Sacramento
19	Salt Slough at Lander Avenue	37.248	-120.852	USGS	CDEC/USGS Sacramento
20	Los Banos Creek Flow Station	37.275	-120.955	Grassland WD	Lara Sparks
21	Orestimba Creek at River Road	37.414	-121.015	USGS	CDEC/USGS Sacramento
22	Modesto ID Lateral 4 to SJR	37.631	-121.159	Modesto ID	Michael Niemi

DO Site	Station Name	Latitude	Longitude	Station Owner	Data Contact/Source
23	Modesto ID Lateral 5 to Tuolumne	37.615	-121.143	Modesto ID	Michael Niemi
24	Modesto ID Lateral 6 to Stanislaus River	37.704	-121.141	Modesto ID	Michael Niemi
25	Modesto ID Main Drain to Stan. R. via Miller Lake	37.670	-121.219	Modesto ID	Michael Niemi
26	Turlock ID Highline Spill	37.387	-120.814	Turlock ID	Kieth Larson
27	Turlock ID Lateral 2 to SJR	37.565	-121.138	Turlock ID	Kieth Larson
28	Turlock ID Westport Drain Flow station	37.542	-121.094	Turlock ID	Kieth Larson
29	Turlock ID Harding Drain	37.464	-121.031	Turlock ID	Kieth Larson
30	Turlock ID Lateral 6 & 7 at Levee	37.398	-120.972	Turlock ID	Kieth Larson
31	BCID – New Jerusalem Drain	37.727	-121.300	SJVDA	UOP EERP
33	Hospital Creek	37.610	-121.231	SJVDA	UOP EERP
34	Ingram Creek	37.600	-121.225	SJVDA	UOP EERP
35	Westley Wasteway Flow Station	37.558	-121.164	SJVDA	UOP EERP
36	Del Puerto Creek Flow Station	37.539	-121.122	SJVDA	UOP EERP
38	Marshall Road Drain	37.436	-121.036	SJVDA	UOP EERP
40	Patterson Irrigation District Diversion	37.497	-121.083	PID	John Sweigart
41	West Stanislaus Irrigation District Diversion	37.584	-121.201	WSID	Ron Roos
42	Banta Carbona Irrigation District Diversion	37.713	-121.311	BCID	David Wisenberger
43	El Solyo Water District Diversion	37.640	-121.229	ESWD	John Hanson (DPWD)

DO Site	Station Name	Latitude	Longitude	Station Owner	Data Contact/Source
44	San Luis Drain End	37.261	-120.905		Chris Linneman
45	Volta Wasteway at Ingomar Grade	37.105	-120.936	Grassland WD	Lara Sparks
46	Mud Slough at Gun Club Road	37.231	-120.899	Grassland WD	Lara Sparks
47	Delta-Mendota Canal at HW 140 (O'Neill Forebay)	37.246	-121.077	Delta-Mendota Canal Company	Chris Linneman
48	San Luis Drain Site A (Check 17)	36.967	-120.671	GBP	SFEI
49	PE-14 – Grasslands Area Farmers	36.939	-120.636	SJVDA	Joe McGahan, Mike Gardener
50	FC-5 – Grassland Area Farmers	36.924	-120.654	SJVDA	Joe McGahan, Mike Gardener
53	Salt Slough at Wolfsen Road	37.159	-120.813	SLNWR	USFWS
57	Ramona Drain at Levee	37.479	-121.069	SJVDA	UOP EERP
59	SJR Laird Park	37.557	-121.150	No station	Calculated Flow
60	Moffit 1 South	37.221	-120.832	SLNWR	USFWS
61	Deadmans Slough	37.215	-120.826	SLNWR	USFWS
62	Mallard Slough	37.192	-120.824	SLNWR	USFWS
63	Inlet C Canal	37.172	-120.762	SLNWR	USFWS
64	Moran Drain	37.435	-121.036	SJVDA	UOP EERP
65	Spanish-Grant Drain	37.436	-121.036	SJVDA	UOP EERP
68	S-Lake Basin	37.253	-120.918	Grassland WD	Lara Sparks

End Table 1

Table 2: Equipment descriptions.

<i>Device</i>	<i>Description</i>
Campbell Logger (Campbell Scientific Inc., Logan, UT)	Logger put into continuous monitoring stations. Records and stores data from EC probe, flow device, and bubbler.
H-350XL Design Analysis Logger (Design Analysis Associates Inc., Logan, UT)	Logger put into continuous monitoring stations. Records and stores data from EC probe, flow device, and bubbler.
MACE Agriflo (MACE, Sydney, Australia)	Doppler device put near bottom of channel to measure flow. This device is better for defined structures such as pipes and weir structures. Often used at monitoring stations.
Starflow (Unidata, O'Connor, Australia)	Doppler device put near bottom of channel to measure flow. This device is better for defined structures such as pipes and weir structures. Often used at monitoring stations.
Sontek (Sontek/YSI Inc., San Diego, CA)	Doppler device put in channel to measure flow. Sontek units measure flow by looking out into the channel and are better for open, or natural, channel situations. Often used at monitoring stations.
H-350XL/355 Combo Bubbler (Design Analysis Associates Inc., Logan, UT)	A bubbler measures water level by detecting the pressure required to force air through a tube below the water level in the channel. In areas with a weir system a bubbler can be used to measure flow, as the height of water above the weir is proportional to the flow.
Staff Gauge (Wildlife Supply Company, Buffalo, NY)	A gauge put in a fixed location to observe water level. Often used to verify bubbler reading during QA visits.
Cal Poly ITRC Weir Stick (Cal Poly ITRC, San Luis Obispo, CA)	Scale mounted on a stick used to measure the height of the water above a weir structure. This value is then multiplied times the weir width to get flow.

Table 3: Summary flow statistics for annual year 2005.

Site No.	Site name	N	Avg. flow (cfs)	Min. flow (cfs)	Max. flow (cfs)	S.D. flow (cfs)
84	SJR at Garwood Bridge (Hwy 4)	22685	3144	-3237	8376	2308
3	SJR at Old River (DWR Lathrop)	20976	3339	-2917	9532	1848
5	SJR at Vernalis	34915	5529	520	16200	3749
7	SJR at Patterson	33221	2356	689	12921	2281
8	SJR at Crows Landing	33591	2499	693	10300	1934
9	SJR at Fremont Ford	33508	885	135	4350	1000
10	SJR at Lander Avenue	34900	697	3	7923	1138
13	Stanislaus River at Ripon	33857	533	217	4350	490
15	Tuolumne River at Modesto	34376	2282	270	8600	1807
17	Merced River near Stevinson	30929	1162	183	4998	1086
18	Mud Slough near Gustine	34661	170	0	639	138
19	Salt Slough at Lander Avenue	34671	239	40	1080	156
20	Los Banos Creek at Highway 140	33882	51	-2	202	55
21	Orestimba Creek at River Road	33017	60	0	1280	111
22	MID Lateral 4 to SJR	306	5	0	49	9
23	MID Lateral 5 to Tuolumne	365	13	0	48	12
24	MID Lat 6 to Stanislaus River	365	26	0	89	23
25	MID Main Drain to Stan. R. via Miller Lake	275	11	0	142	21
26	TID Highline Spill	365	18	0	104	25
27	TID Lateral 2	365	3	0	27	4
29	TID Harding Drain	365	35	0	107	20
30	TID Lateral 6 & 7 at Levee	365	24	0	85	17
31	BCID – New Jerusalem Drain	3624	1	0	2	0
33	Hospital Creek	35068	4	0	22	3
34	Ingram Creek	19149	10	0	105	10
35	Westley Wasteway Flow Station	34992	3	0	12	2
36	Del Puerto Creek Flow Station	35039	8	0	34	7
38	Marshall Road Drain	37761	2	0	11	2
40	Patterson Irrigation District (diversions)	12	48	0	125	51
41	West Stanislaus Irrigation District (diversions)	365	108	0	461	139
42	Banta Carbona Irrigation District (diversions)	365	65	0	228	73
43	El Solyo Pumping Station (diversions)	12	15	0	47	17
44	San Luis Drain End	24804	49	23	138	14
45	Volta Wasteway	31497	105	1	542	107
46	Mud Slough at Gun Club Road	28431	28	0	99	22
47	Delta-Mendota Canal Inlet to the O'Neill Forebay	365	1260	50	3850	1011
48	FC-5 Grasslands Area Farmers	35033	37	8	159	18
49	PE-14 Grasslands Area Farmers	32075	11	0	160	10
50	San Luis Drain Site A (Check 18)	33880	22	4	74	14
53	Salt Slough at Wolfsen Road	20381	202	69	600	57
60	Moffit 1 South	8570	1	0	28	2
62	Mallard Slough	8573	9	0	30	6
63	Inlet C Canal	8759	37	-1	98	28
64	Moran Drain	37719	2	0	60	3
65	Spanish Grant Drain	37719	6	0	124	9
68	S. Lake Basin	30318	34	-1	157	34

Table 4: Summary flow statistics for annual year 2006.

Site No.	Site name	N	Avg. flow (cfs)	Min. flow (cfs)	Max. flow (cfs)	S.D. flow (cfs)
84	SJR at Garwood/HW 4	21892	4625	-3562	16089	4673
3	SJR at Old River (DWR Lathrop)	34674	-283	-12256	15010	8410
4	SJR at Mossdale	34654	9012	4	29425	7408
5	SJR at Vernalis	34605	10348	690	36098	9190
6	SJR at Maze	342	8423	1168	34077	8102
7	SJR at Patterson	34925	4936	675	27953	5857
8	SJR at Crows Landing	34172	4857	716	34300	5676
9	SJR at Fremont Ford	34201	2165	131	21600	3189
10	SJR at Lander Avenue	34411	2743	0	23438	4841
13	Stanislaus River at Ripon	34680	2198	453	6270	1466
15	Tuolumne River at Modesto	31003	3229	60	11400	2531
17	Merced River near Stevinson	14578	2845	595	6045	1548
18	Mud Slough near Gustine	34132	266	24	1140	213
19	Salt Slough at Lander Avenue	34655	440	40	2150	424
20	Los Banos Creek at Highway 140	11440	49	3	131	25
21	Orestimba Creek at River Road	32218	64	0	3190	234
22	MID Lateral 4 to SJR	6139	14	0	90	17
23	MID Lateral 5 to Tuolumne	6140	24	0	113	20
24	MID Lat 6 to Stanislaus River	6140	42	0	125	24
25	MID Main Drain to Stan. R. via Miller Lake	3581	16	0	208	15
26	TID Highline Spill	365	14	0	67	18
27	TID Lateral 2	365	5	0	35	7
28	TID Westport Drain Flow Station	best est.	30	5	50	
29	TID Harding Drain	365	34	4	92	15
30	TID Lateral 6 & 7 at Levee	365	14	0	55	12
31	BCID – New Jerusalem Drain	12949	7	0	19	5
32	El Solyo WD – Grayson Drain	best est.	10	0	20	
33	Hospital Creek	35040	2	0	15	3
34	Ingram Creek	35040	6	0	31	7
35	Westley Wasteway Flow Station	9037	2	0	33	2
36	Del Puerto Creek Flow Station	23459	10	0	49	9
38	Marshall Road Drain	18258	4	0	48	3
40	Patterson Irrigation District (diversions)	8751	41	0	153	54
41	West Stanislaus Irrigation District (diversions)	183	92	0	192	52
42	Banta Carbona Irrigation District (diversions)	364	67	0	254	82
43	El Solyo Pumping Station (diversions)	12	16	0	50	19
44	San Luis Drain End	35902	36	11	179	13
45	Volta Wasteway	31650	82	1	492	81
46	Mud Slough at Gun Club Road	31911	34	-1	131	29
47	Delta-Mendota Canal Inlet to the O'Neill Forebay	365	1083	40	3630	1023
49	PE-14 Grasslands Area Farmers	35040	19	5	76	10
50	San Luis Drain Site A (Check 18)	34922	32	7	191	14
53	Salt Slough at Wolfsen Road	29957	203	19	452	91
54	Los Banos Creek at Ingomar Grade	best est.	5	0	10	
57	Ramona Lake	best est.	20	0	30	
59	SJR Laird Park	342	5219	716	27255	5944
60	Moffit 1 South	8759	1	0	11	3
61	Deadman's Slough	8758	8	0	56	14
62	Mallard Slough	8759	8	0	49	10
63	Inlet C Canal	8568	22	0	113	22

Site No.	Site name	N	Avg. flow (cfs)	Min. flow (cfs)	Max. flow (cfs)	S.D. flow (cfs)
64	Moran Drain	30792	2	0	20	3
65	Spanish Grant Drain	27658	9	0	53	10
66	ESWD Maze Blv. Drain	best est.	5	0	15	
67	Newman Wasteway at Brazo Road	best est.	5	0	30	
68	S. Lake Basin	32371	25	-1	232	24
95	Ramona Drain at Ramona Lake	best est.	20			

End of Table 4

Table 5: Summary flow statistics for annual year 2007.

Site No.	Site name	N	Avg. flow (cfs)	Min. flow (cfs)	Max. flow (cfs)	S.D. flow (cfs)
1	SJR at Channel Point (Rough and Ready Island)	34137	1160	-16346	62246	4663
84	SJR at Garwood/HW 4	34581	648	-4273	4792	2157
3	SJR at Old River (DWR Lathrop)	31986	384	-1827	2444	801
4	SJR at Mossdale	33604	1699	-1056	5782	938
5	SJR at Vernalis	34535	1889	533	4321	771
6	SJR at Maze	25057	1078	312	2176	413
7	SJR at Patterson	34465	606	109	1328	243
8	SJR at Crows Landing	34090	697	315	1374	253
9	SJR at Fremont Ford	33481	189	33	781	96
10	SJR at Lander Avenue	34294	36	3	616	61
13	Stanislaus River at Ripon	34562	678	227	1510	413
15	Tuolumne River at Modesto	33979	368	186	1070	173
17	Merced River near Stevenson	29746	367	15	1330	300
18	Mud Slough near Gustine	34480	96	8	245	64
19	Salt Slough at Lander Avenue	34484	155	50	363	66
20	Los Banos Creek at Highway 140	24323	23	0	132	20
21	Orestimba Creek at River Road	28880	8	0	152	10
22	MID Lateral 4 to SJR	5227	8	0	86	12
23	MID Lateral 5 to Tuolumne	5236	23	0	98	19
24	MID Lat 6 to Stanislaus River	5242	22	0	107	25
25	MID Main Drain to Stan. R. via Miller Lake	7781	12	0	55	9
26	TID Highline Spill	365	7	0	53	8
27	TID Lateral 2	365	5	0	30	6
28	TID Westport Drain Flow Station	365	25	0	101	18
29	TID Harding Drain	365	36	0	89	15
30	TID Lateral 6 & 7 at Levee	365	11	0	43	10
31	BCID - New Jerusalem Drain	365	4	1	11	3
33	Hospital Creek	35040	3	0	17	3
34	Ingram Creek	35041	6	0	25	6
35	Westley Wasteway Flow Station	33274	2	0	42	2
36	Del Puerto Creek Flow Station	33559	17	0	90	16
38	Marshall Road Drain	34492	3	0	47	3
41	West Stanislaus Irrigation District (diversions)	365	67	0	203	54
42	Banta Carbona Irrigation District (diversions)	365	79	0	189	69
43	El Solyo Pumping Station (diversions)	12	22	0	73	22
44	San Luis Drain End	35039	25	1	54	10
45	Volta Wasteway	24318	45	1	469	59
46	Mud Slough at Gun Club Road	24908	19	-13	76	23
47	Delta-Mendota Canal Inlet to the O'Neill Forebay	334	1684	450	3650	784
48	FC-5 Grasslands Area Farmers	365	4	0	15	3
49	PE-14 Grasslands Area Farmers	365	14	4	31	7
53	Salt Slough at Wolfsen Road	22656	137	61	297	42
57	Ramona Lake	25209	6	0	49	6
60	Moffit 1 South	5910	0	0	4	1
61	Deadman's Slough	6634	12	0	100	19
62	Mallard Slough	6632	1	0	47	3
63	Inlet C Canal	4947	26	0	90	23
64	Moran Drain	34493	3	0	31	4
65	Spanish Grant Drain	34491	7	0	69	7
68	S. Lake Basin	24325	13	0	35	11

Site No.	Site name	N	Avg. flow (cfs)	Min. flow (cfs)	Max. flow (cfs)	S.D. flow (cfs)
95	Ramona Drain at Ramona Lake	12001	9	-38	64	9

End of Table 5

Table 6: Water Supply Index (WSI) classification for water years 2000 – 2006

San Joaquin Region 60-20-20		
Water Year	Water Supply Index	Classification
2000	3.38	Above Normal ($> 3.1; < 3.8$)
2001	2.20	Critical (≤ 2.2)
2002	2.34	Dry ($> 2.2; \leq 2.5$)
2003	2.81	Below Normal ($> 2.5; \leq 3.1$)
2004	2.21	Critical (≤ 2.2)
2005	4.75	Wet (≥ 3.8)
2006	5.90	Wet (≥ 3.8)

Figure 1: 2005 through 2007 flow plots for DO-01 SJR at Channel Point

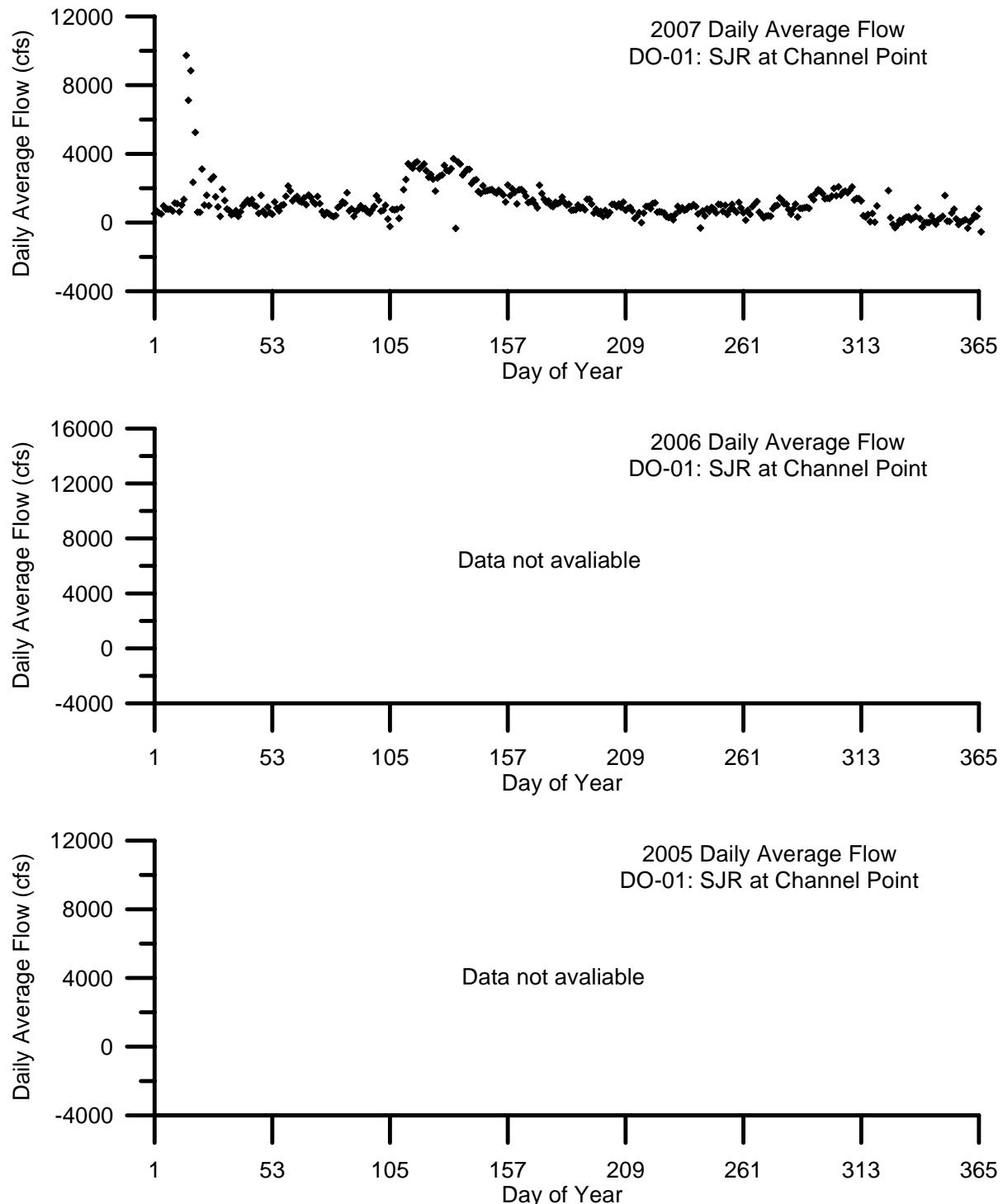


Figure 2: 2005 through 2007 flow plot for DO-01 SJR at Channel Point

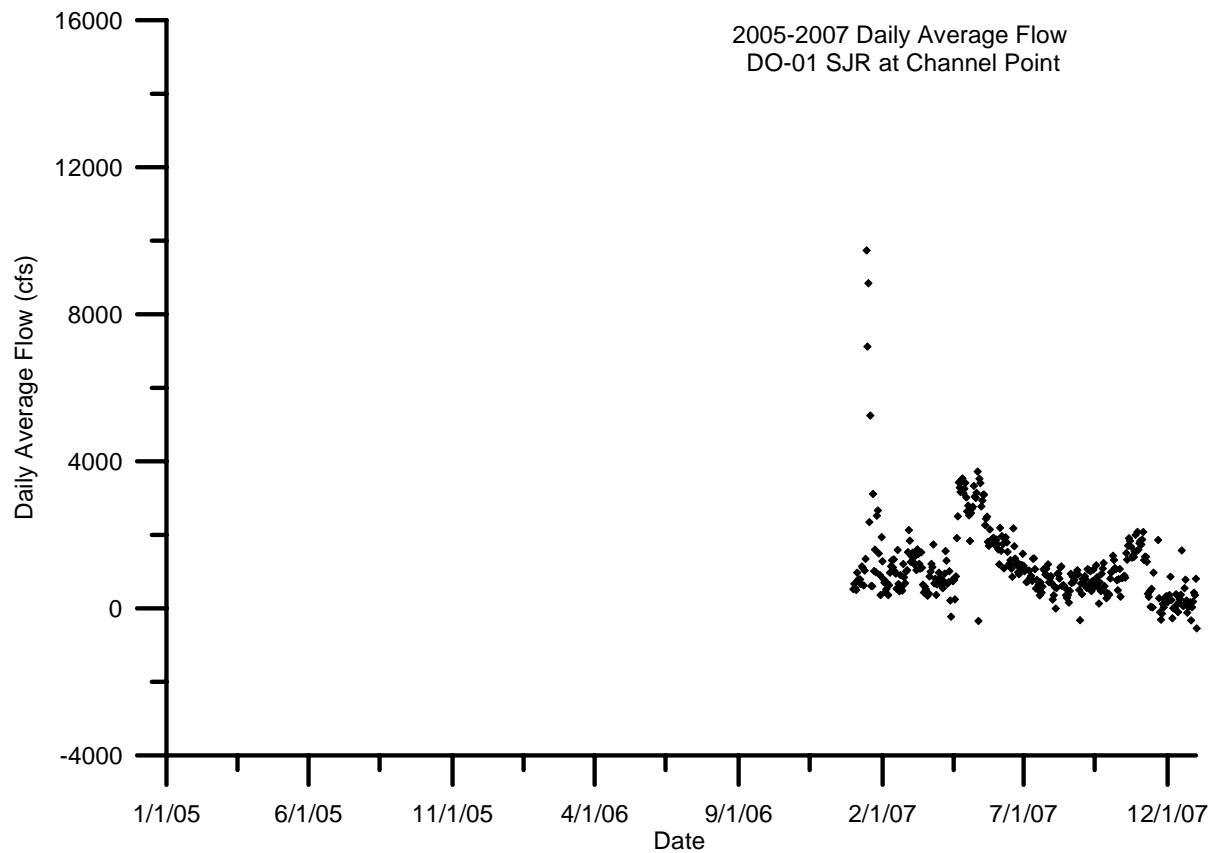


Figure 3: 2005 through 2007 flow plots for DO-84 SJR at Garwood Bridge (Hwy 4)

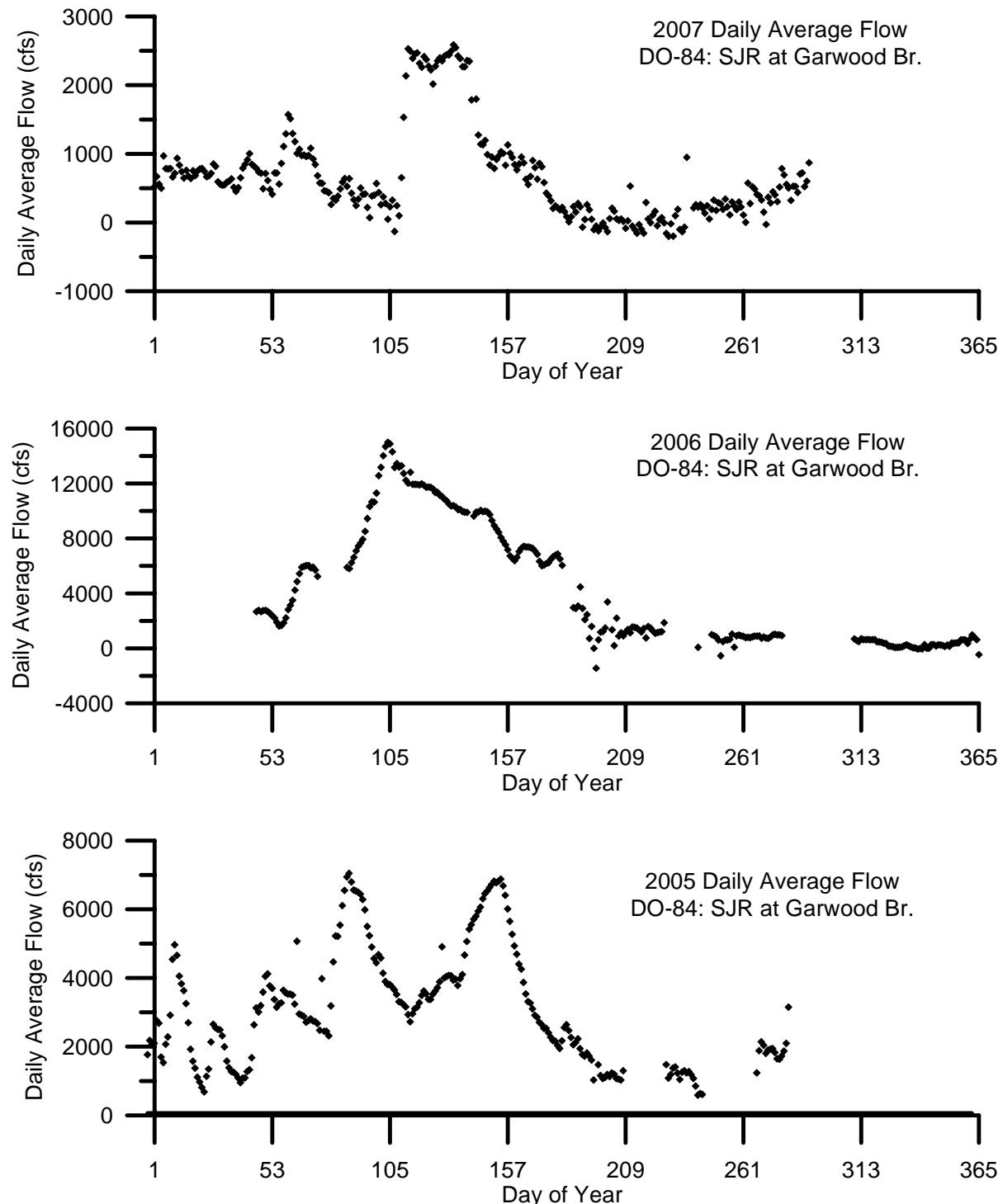


Figure 4: 2005 through 2007 flow plot for DO-84 SJR at Garwood Bridge (Hwy 4)

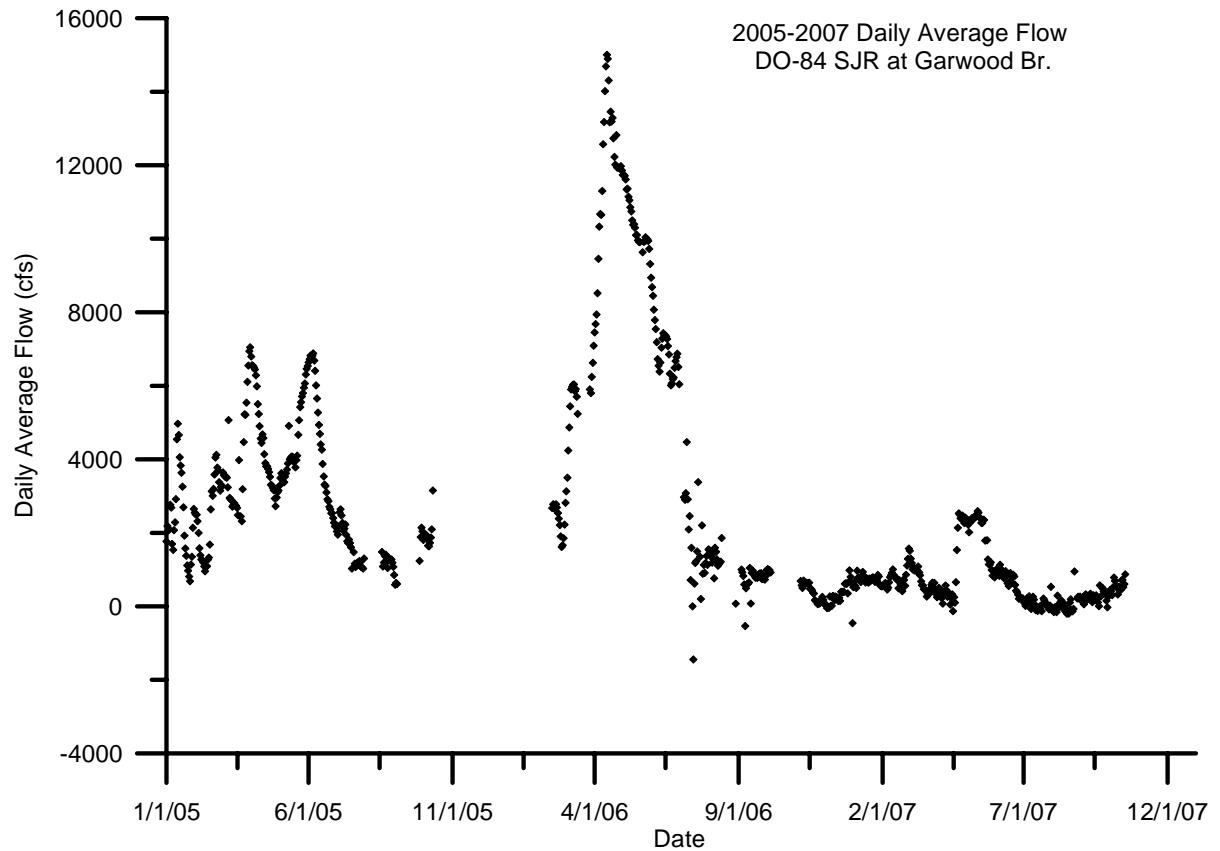


Figure 5: 2005 through 2007 flow plots for DO-03 SJR at Old River

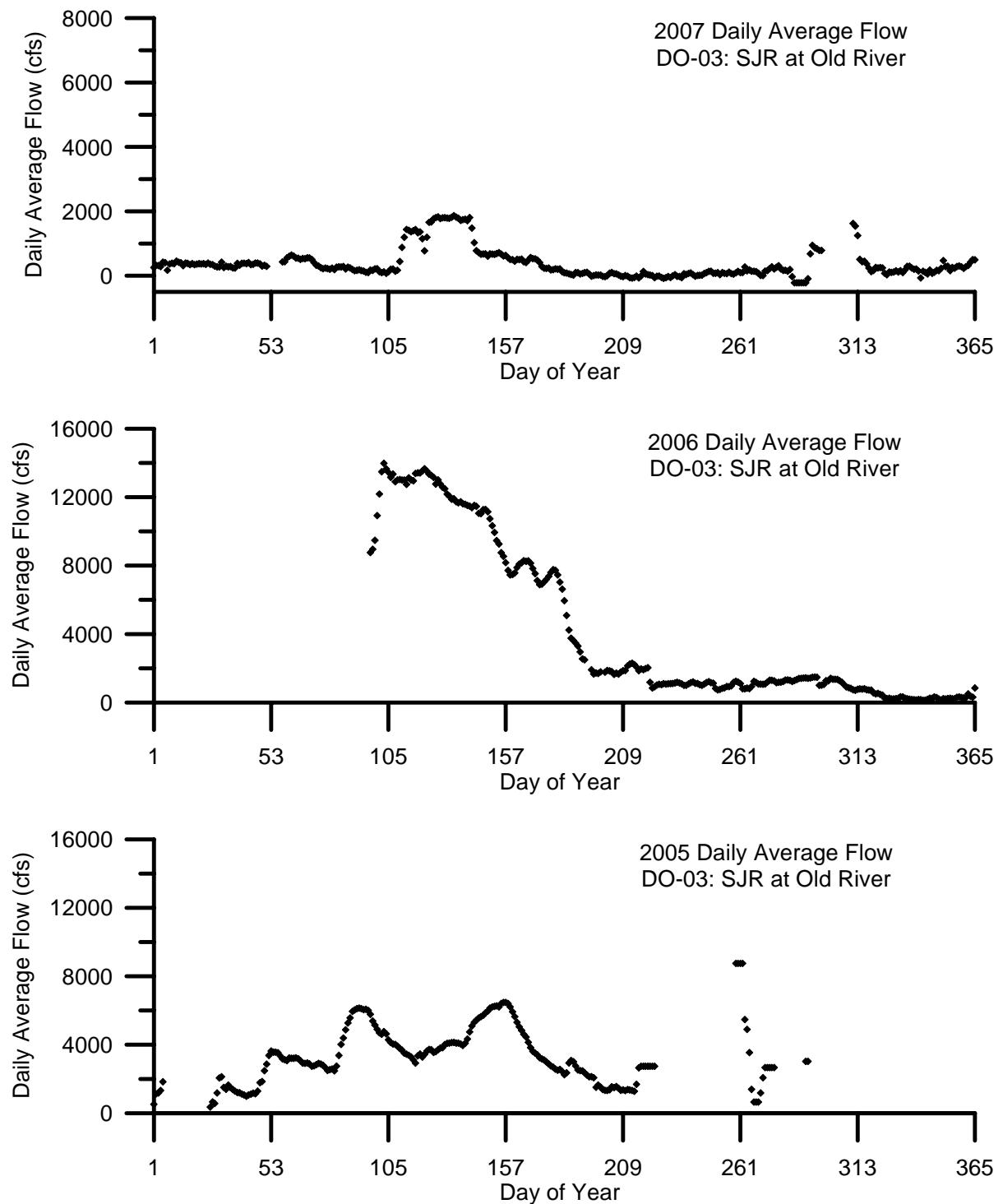


Figure 6: 2005 through 2007 flow plot for DO-03 SJR at Old River

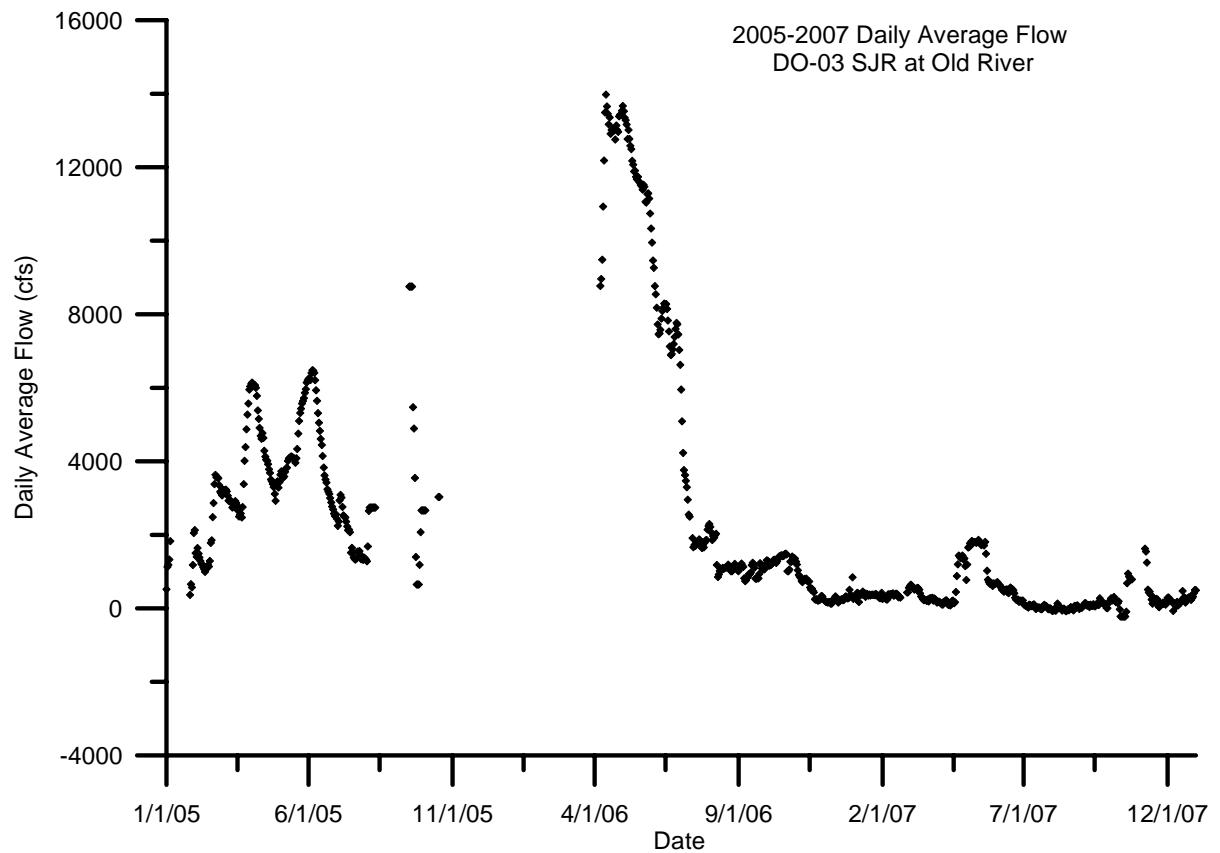


Figure 7: 2005 through 2007 flow plots for DO-04 SJR at Mossdale

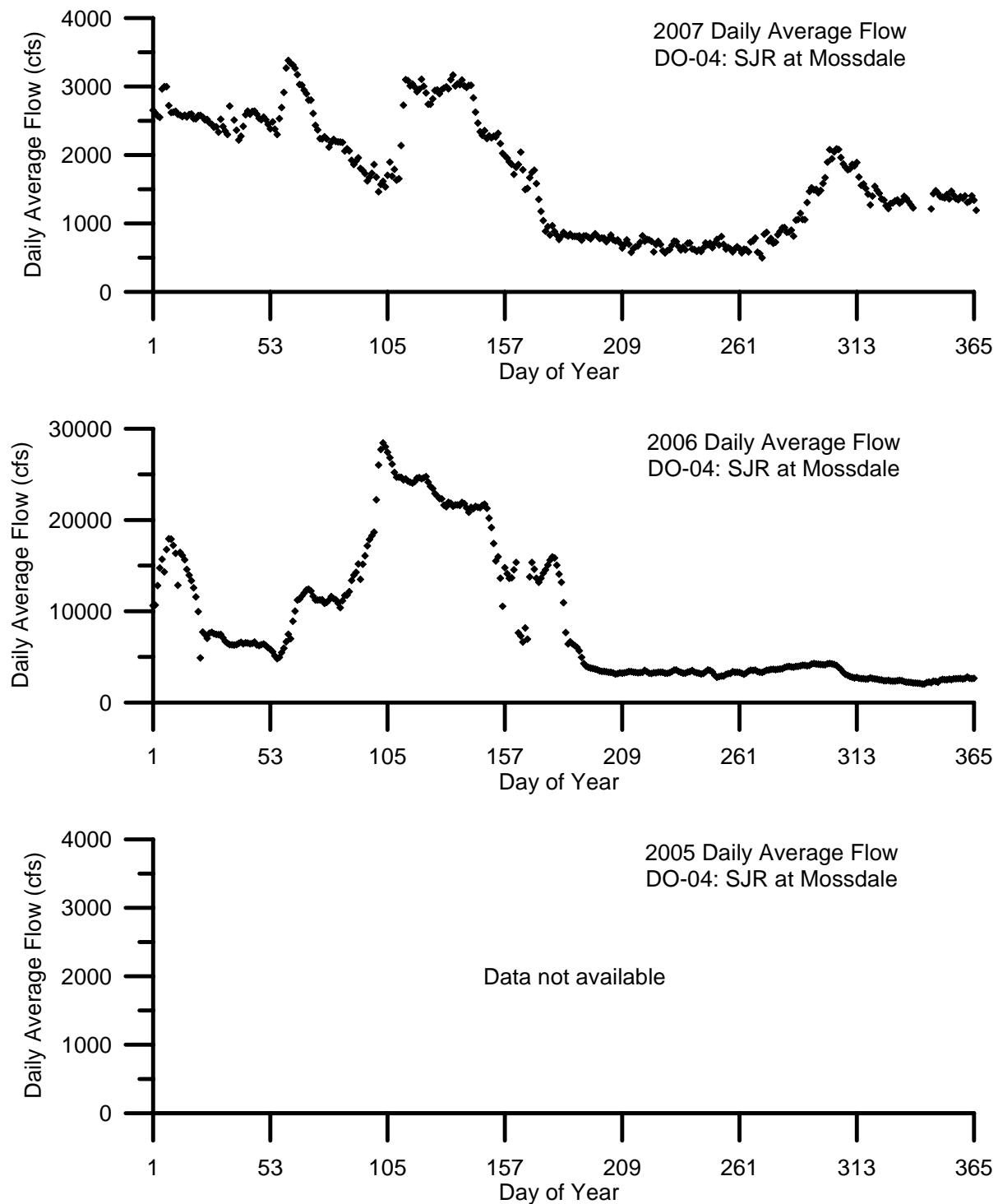


Figure 8: 2005 through 2007 flow plot for DO-04 SJR at Mossdale

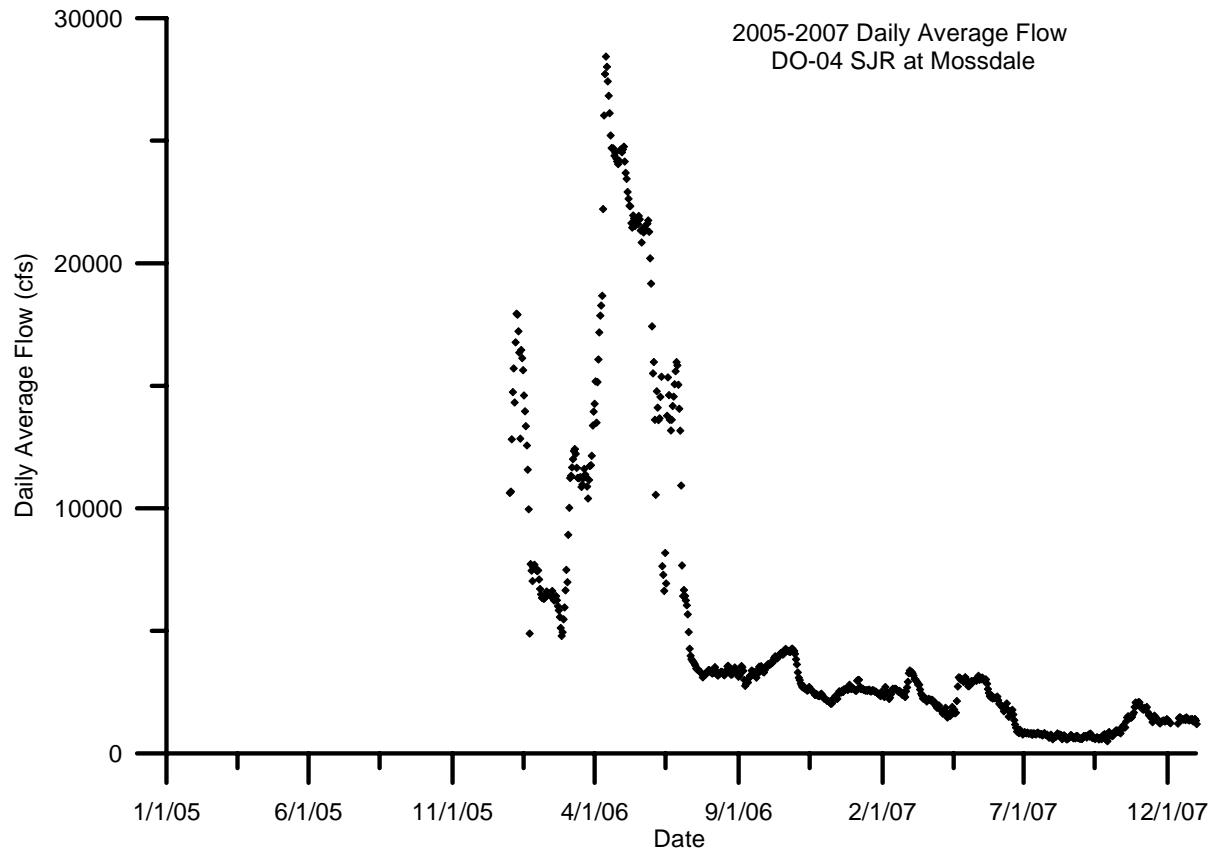


Figure 9: 2005 through 2007 flow plots for DO-05 SJR at Vernalis

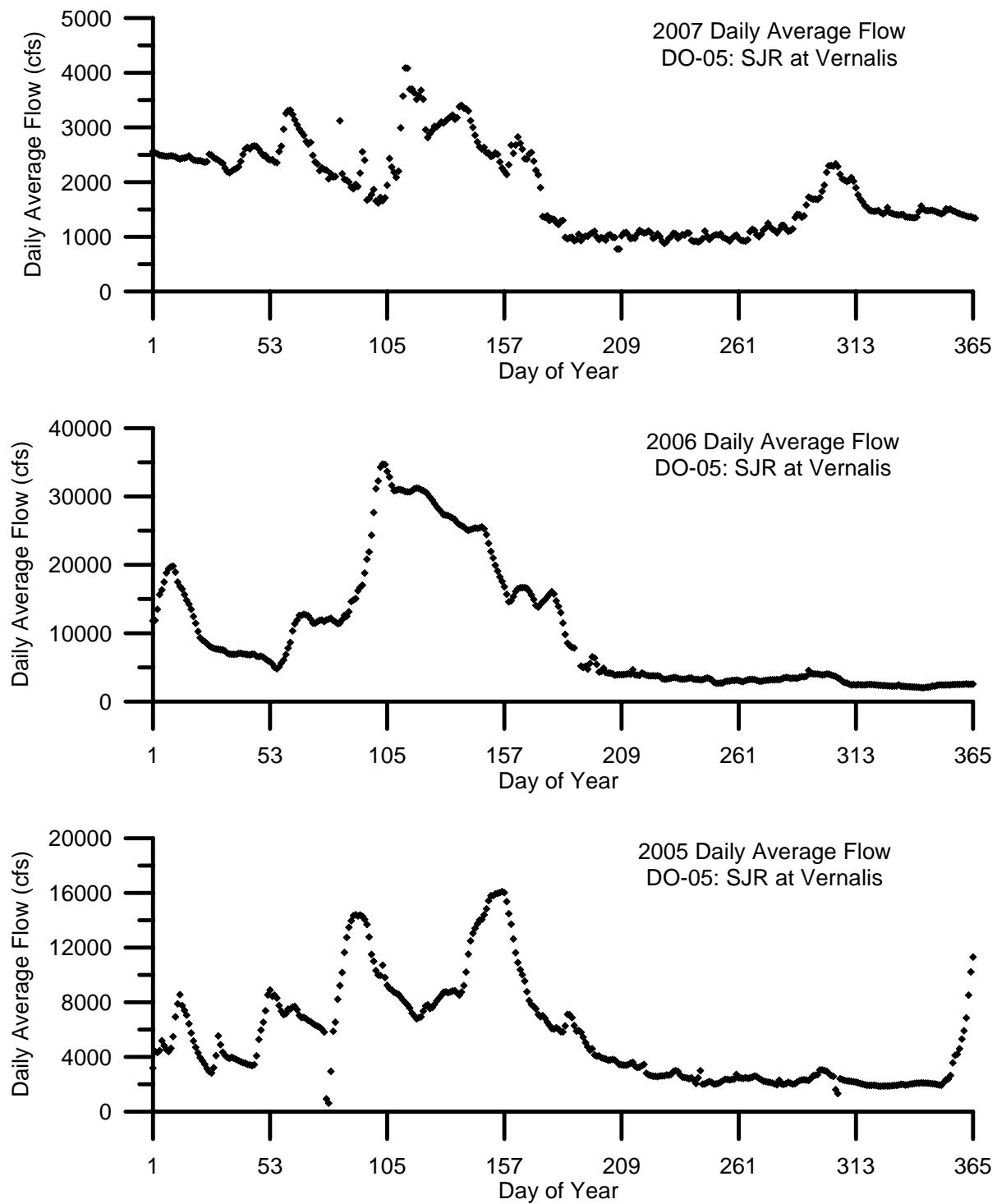


Figure 10: 2005 through 2007 flow plot for DO-05 SJR at Vernalis

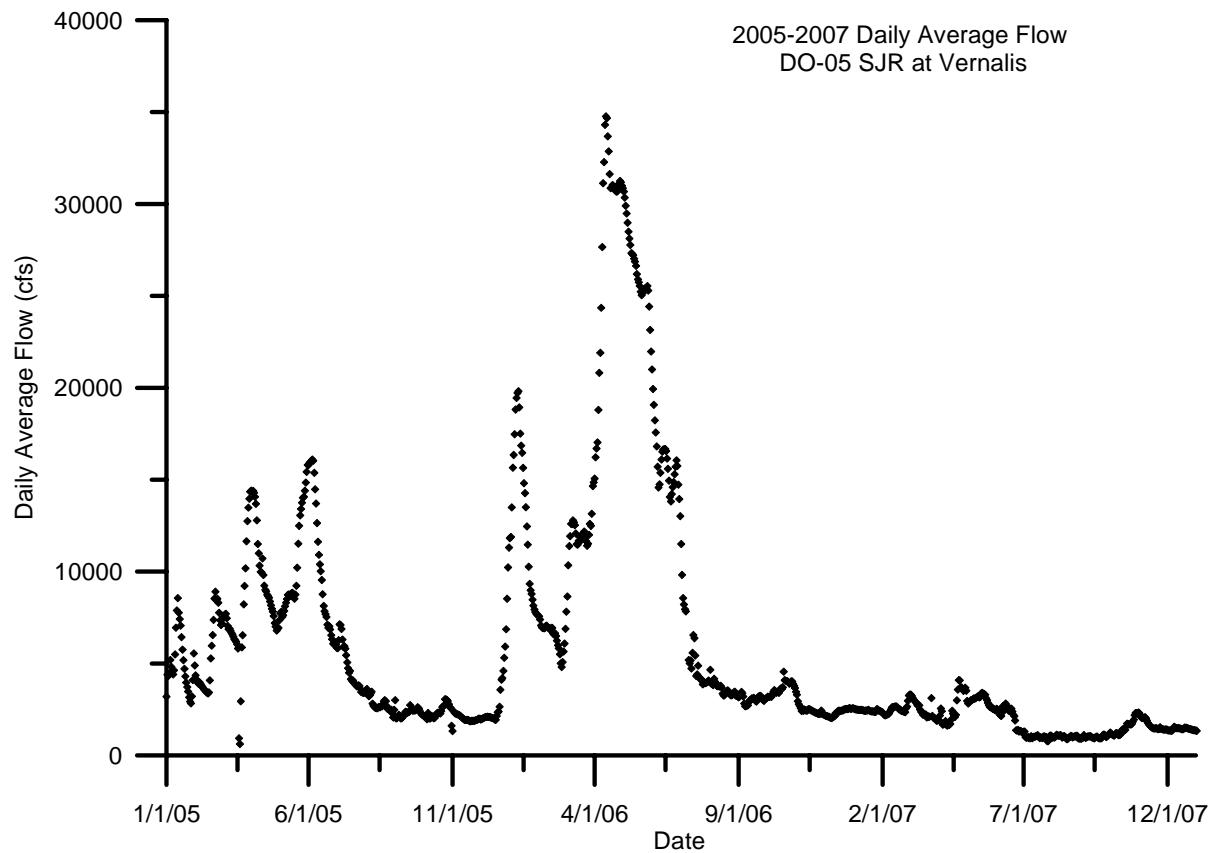


Figure 11: 2005 through 2007 flow plots for DO-06 SJR at Maze

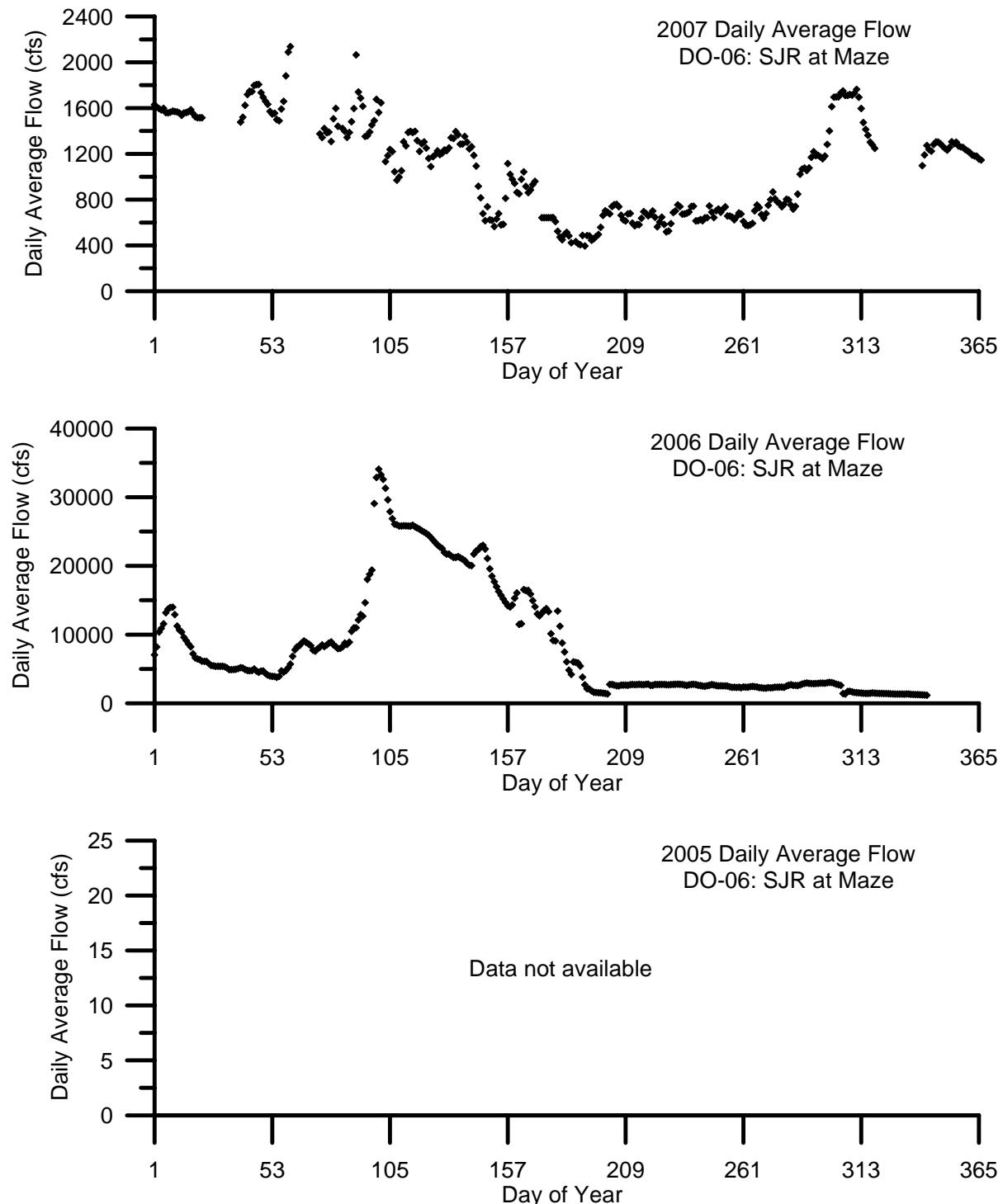


Figure 12: 2005 through 2007 flow plot for DO-06 SJR at Maze

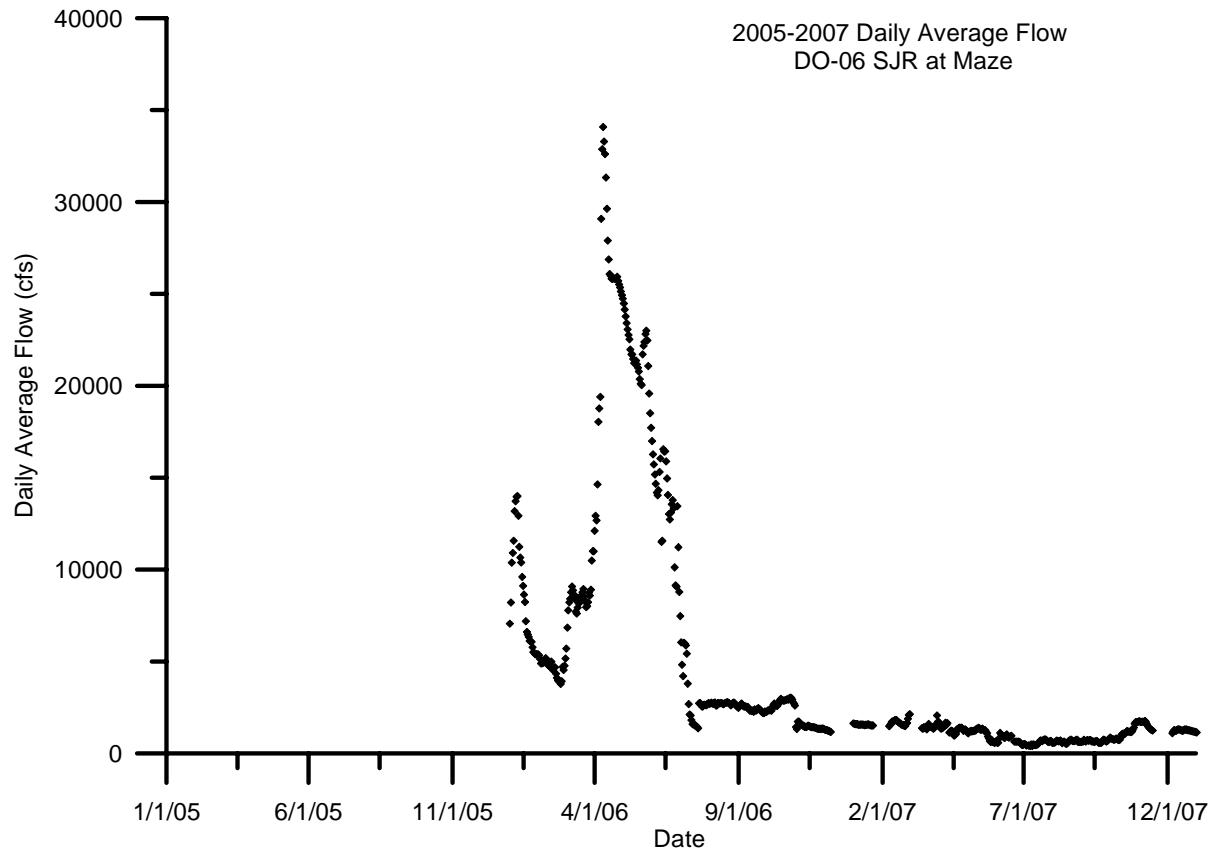


Figure 13: 2005 through 2007 flow plots for DO-07 SJR at Patterson

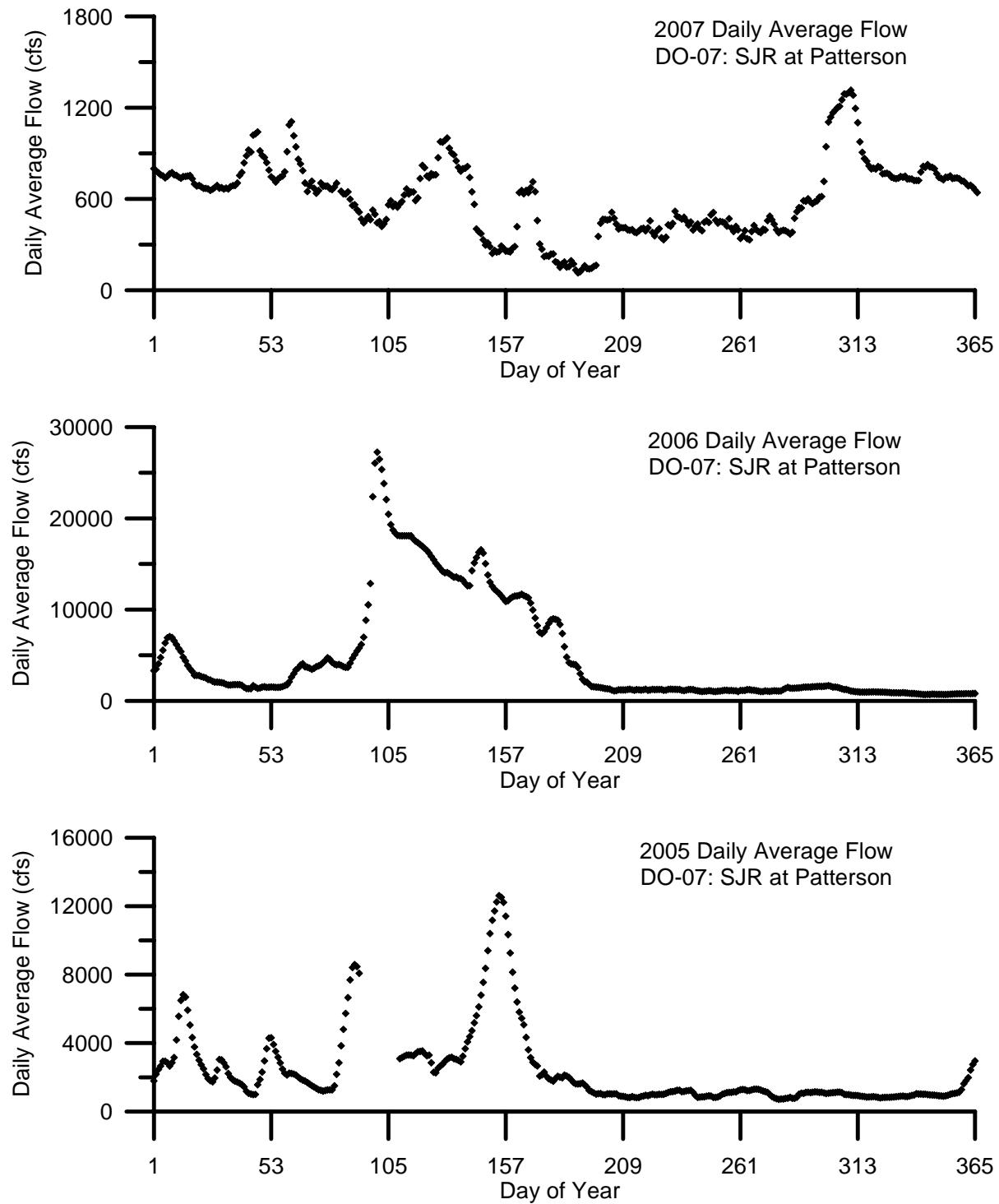


Figure 14: 2005 through 2007 flow plot for DO-07 SJR at Paterson

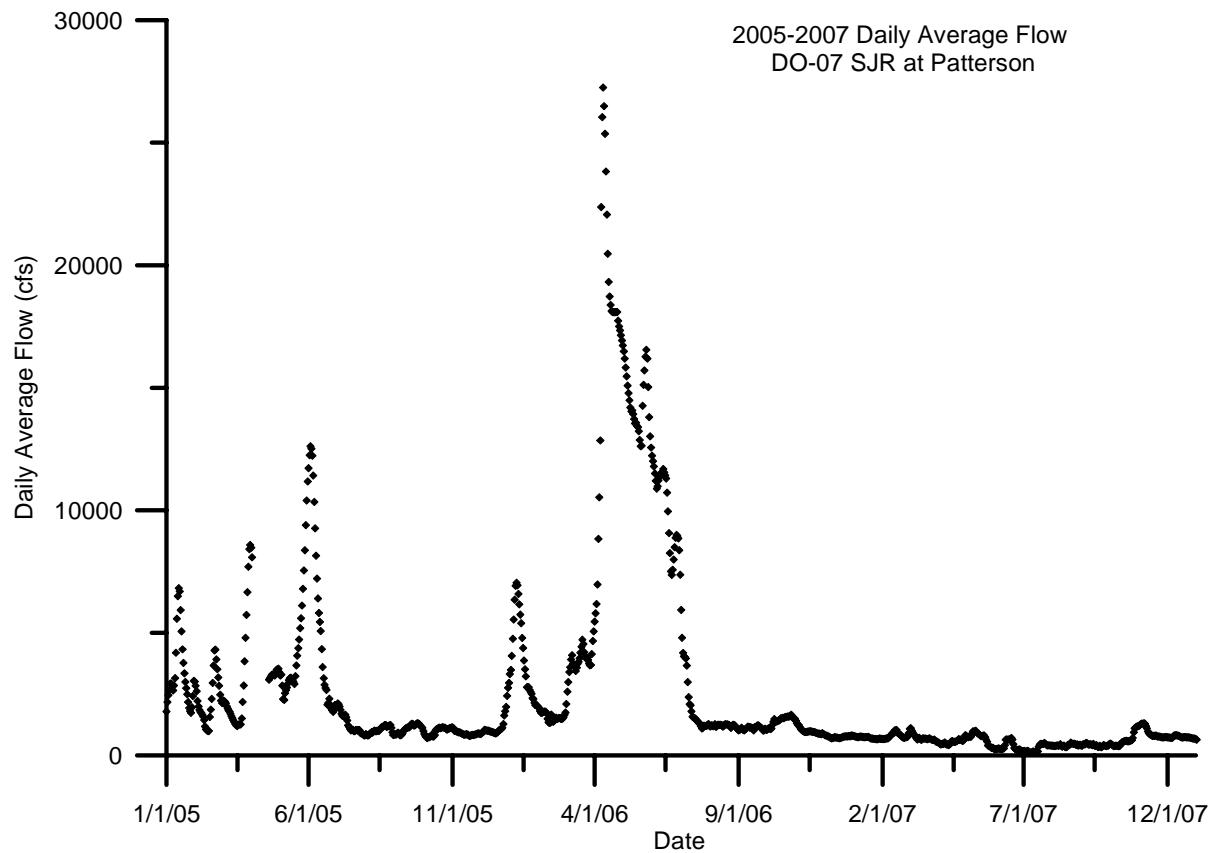


Figure 15: 2005 through 2007 flow plots for DO-08 SJR at Crows Landing

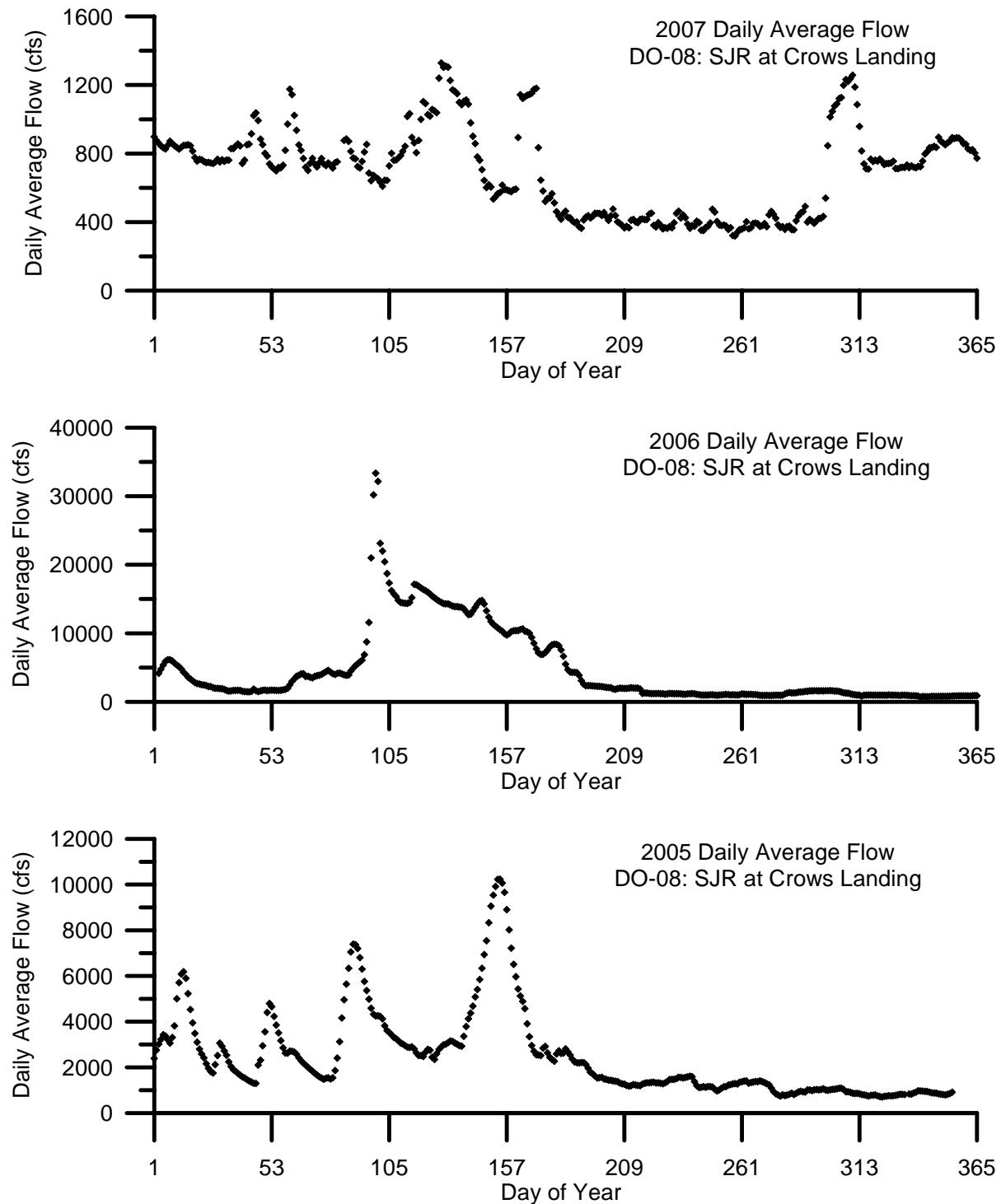


Figure 16: 2005 through 2007 flow plot for DO-08 SJR at Crows Landing

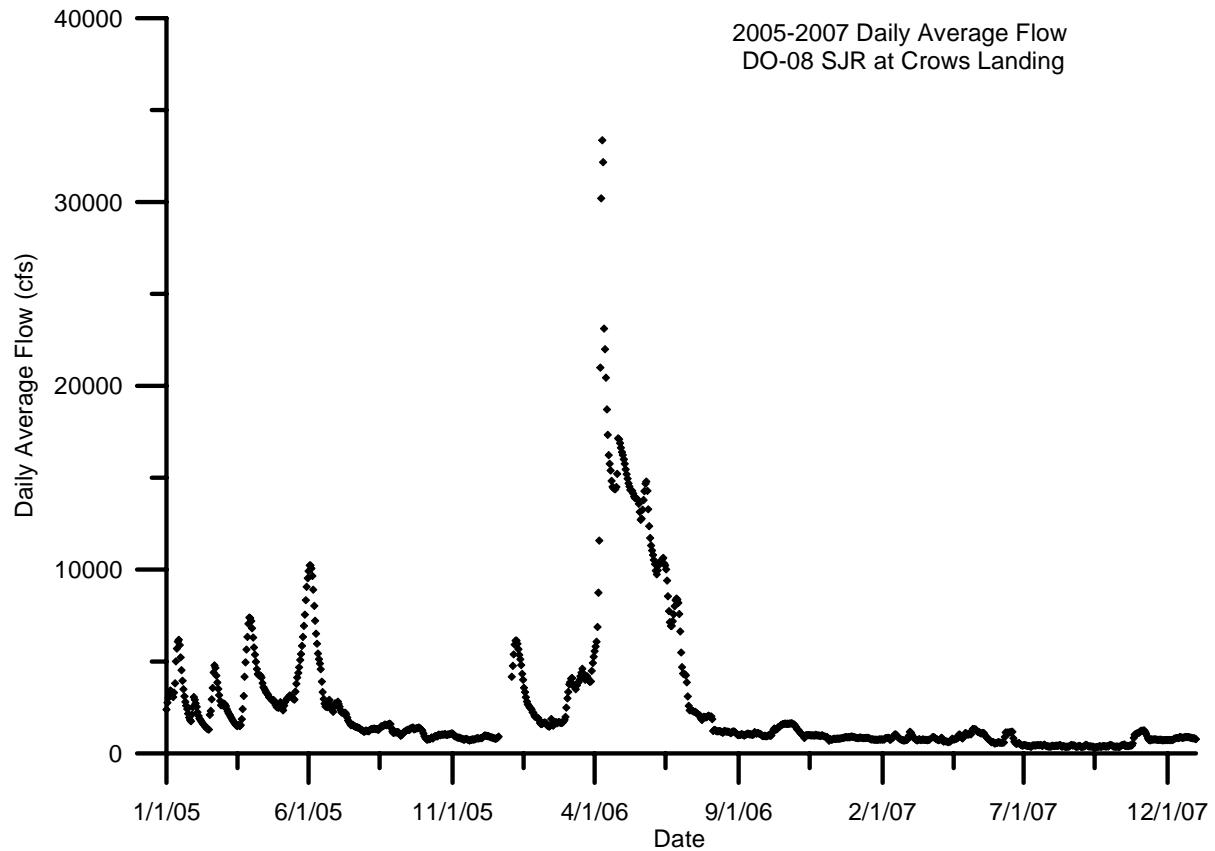


Figure 17: 2005 through 2007 flow plots for DO-09 SJR at Fremont Ford

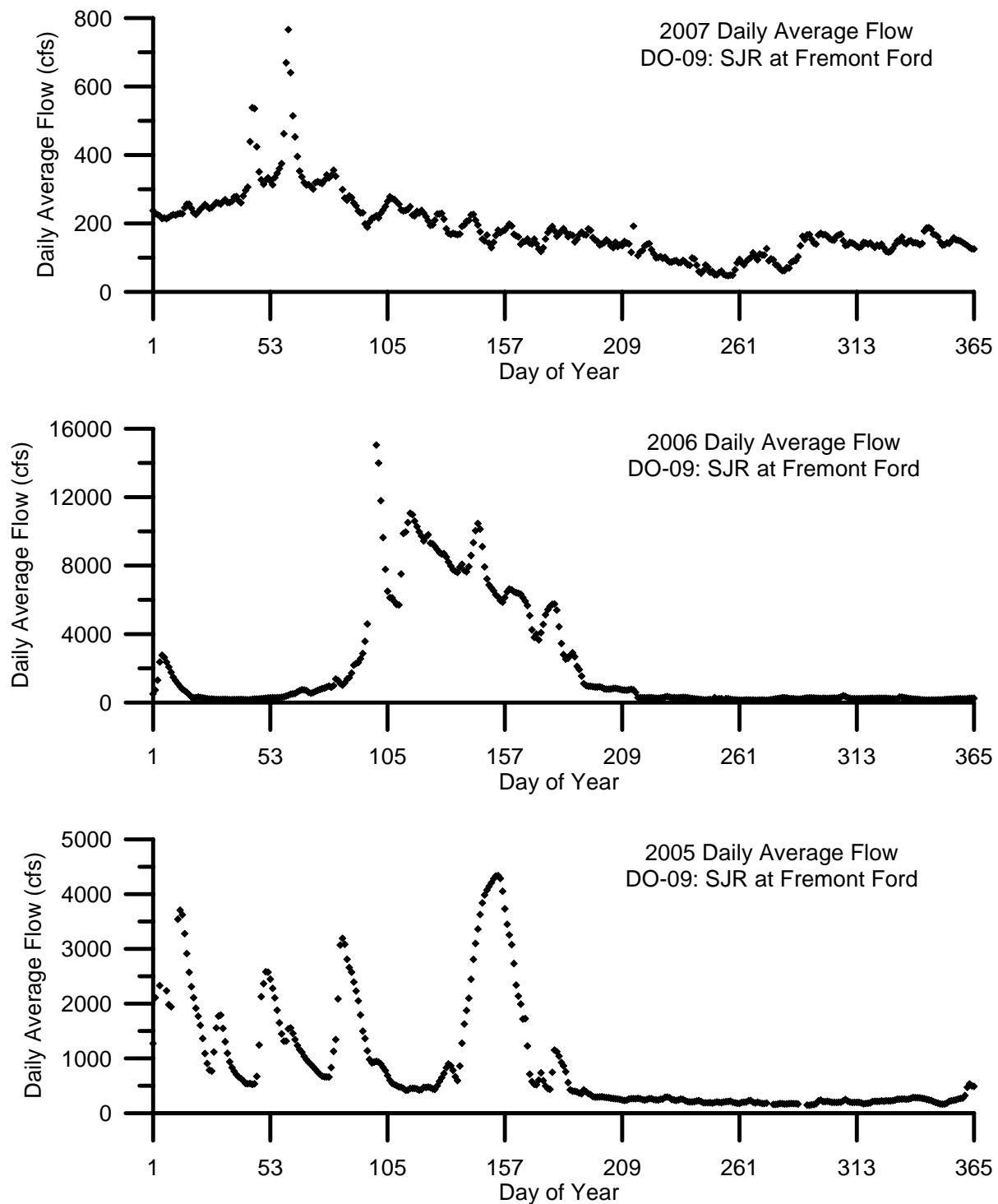


Figure 18: 2005 through 2007 flow plot for DO-09 SJR at Fremont Ford

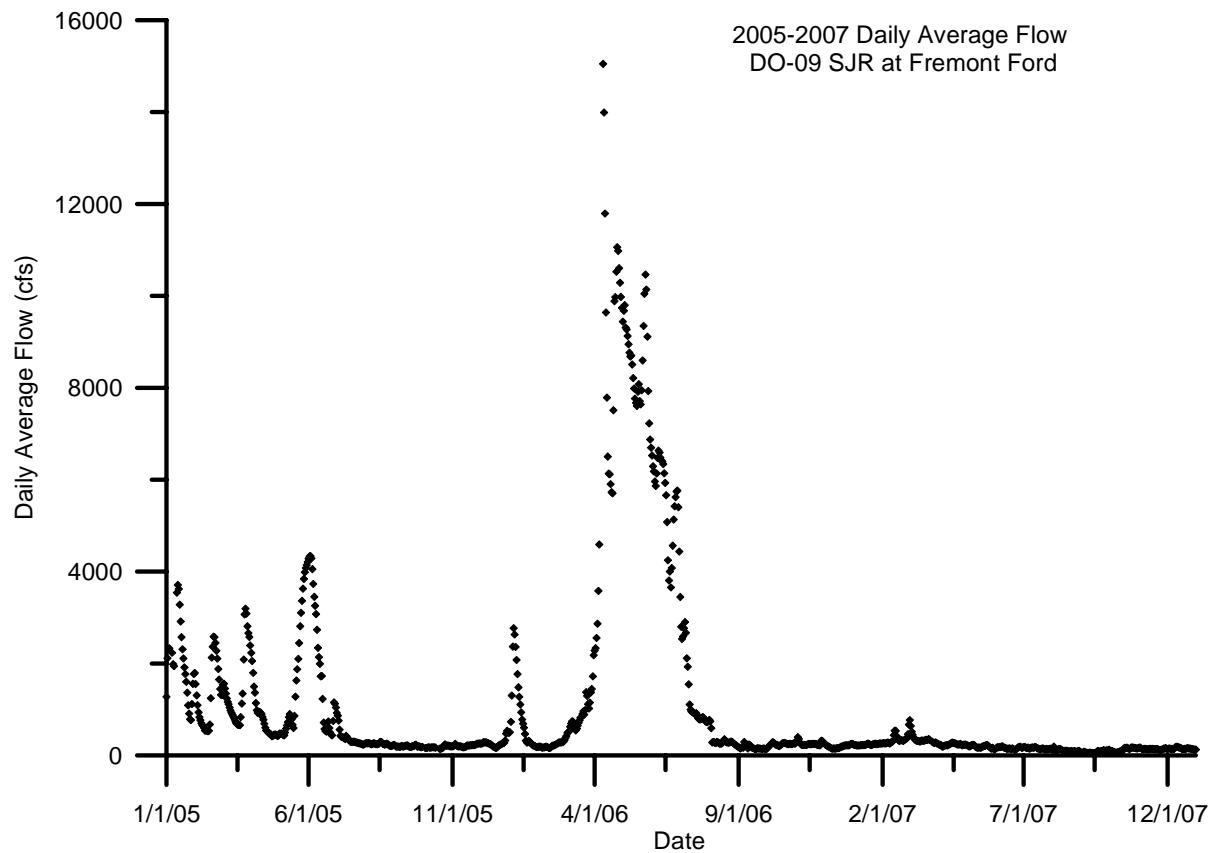


Figure 19: 2005 through 2007 flow plots for DO-10 SJR at Lander Avenue

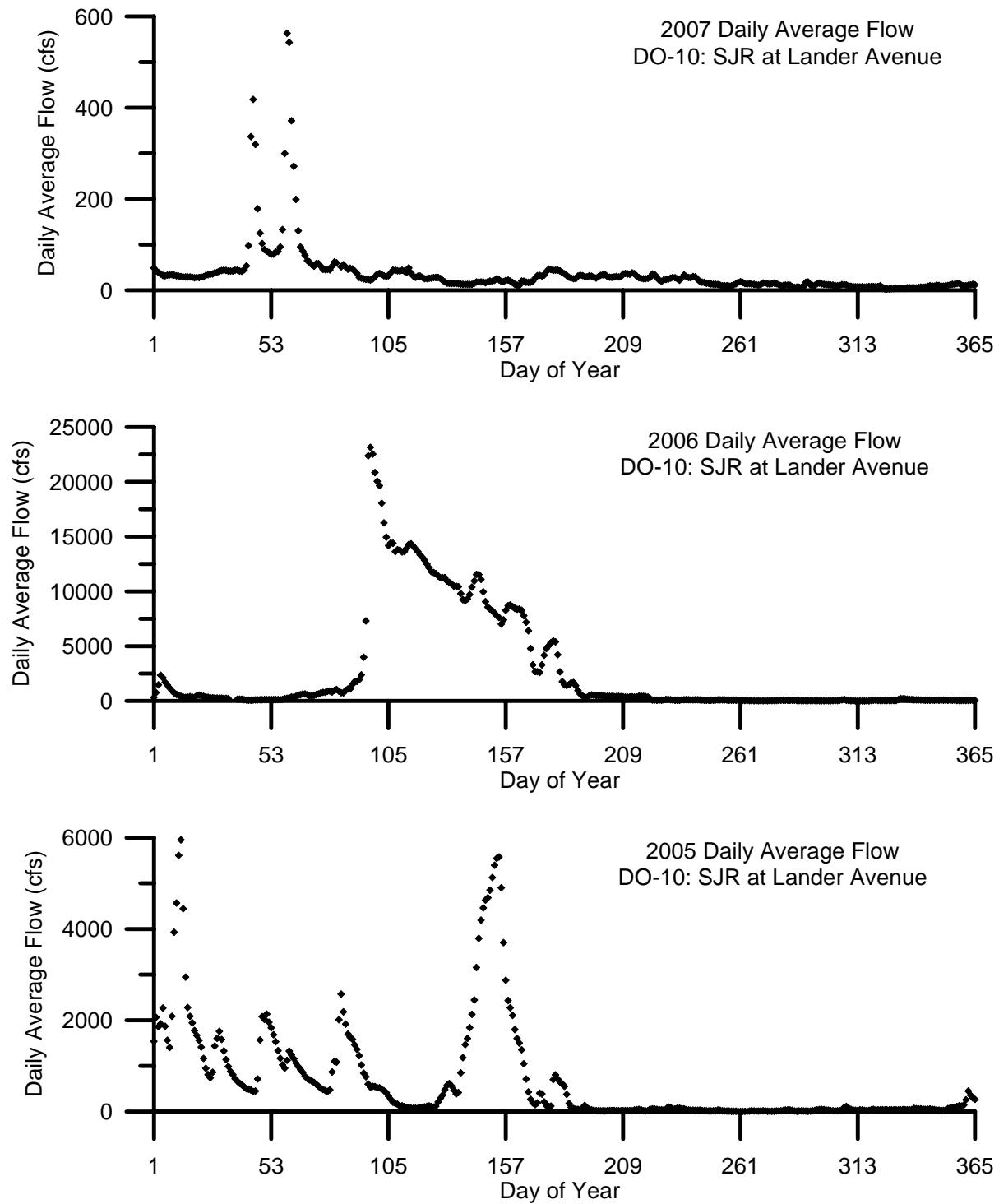


Figure 20: 2005 through 2007 flow plot for DO-10 SJR at Lander Avenue

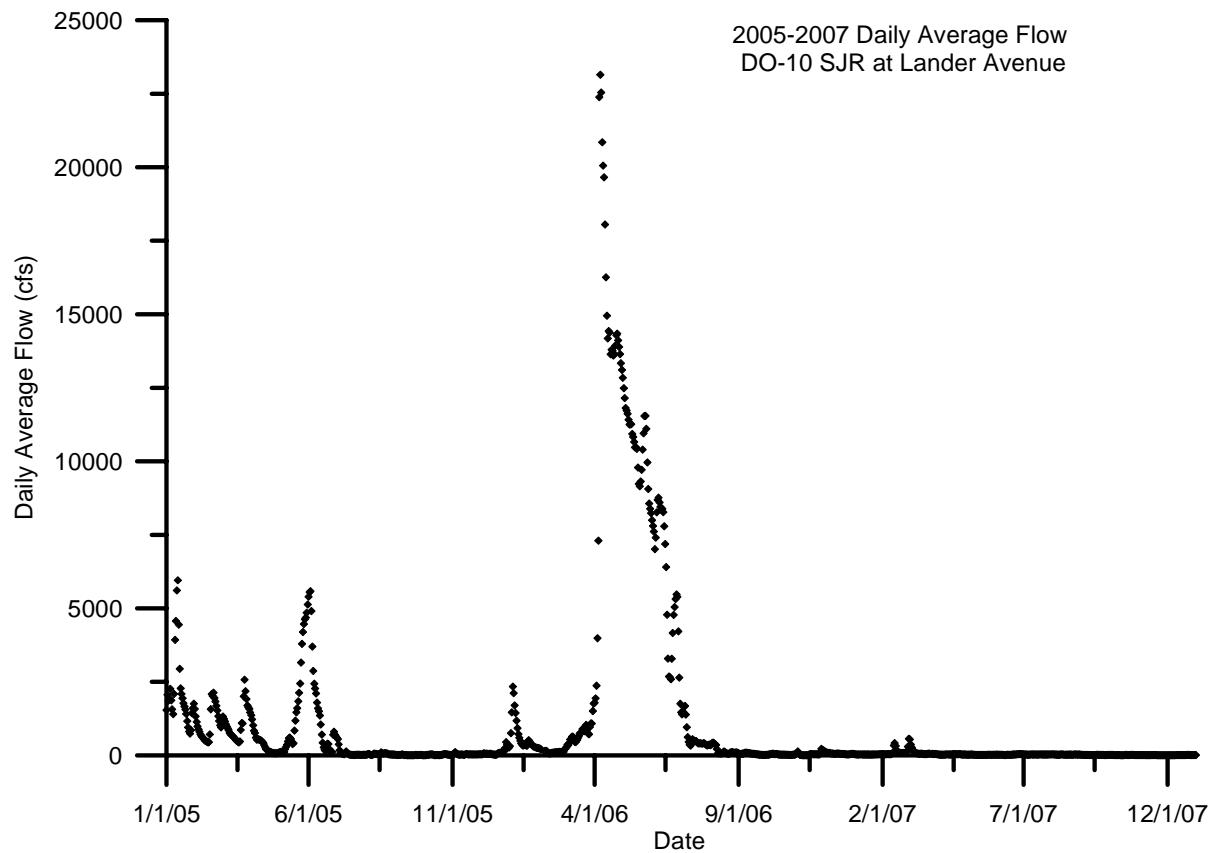


Figure 21: 2005 through 2007 flow plots for DO-13 Stanislaus River at Ripon

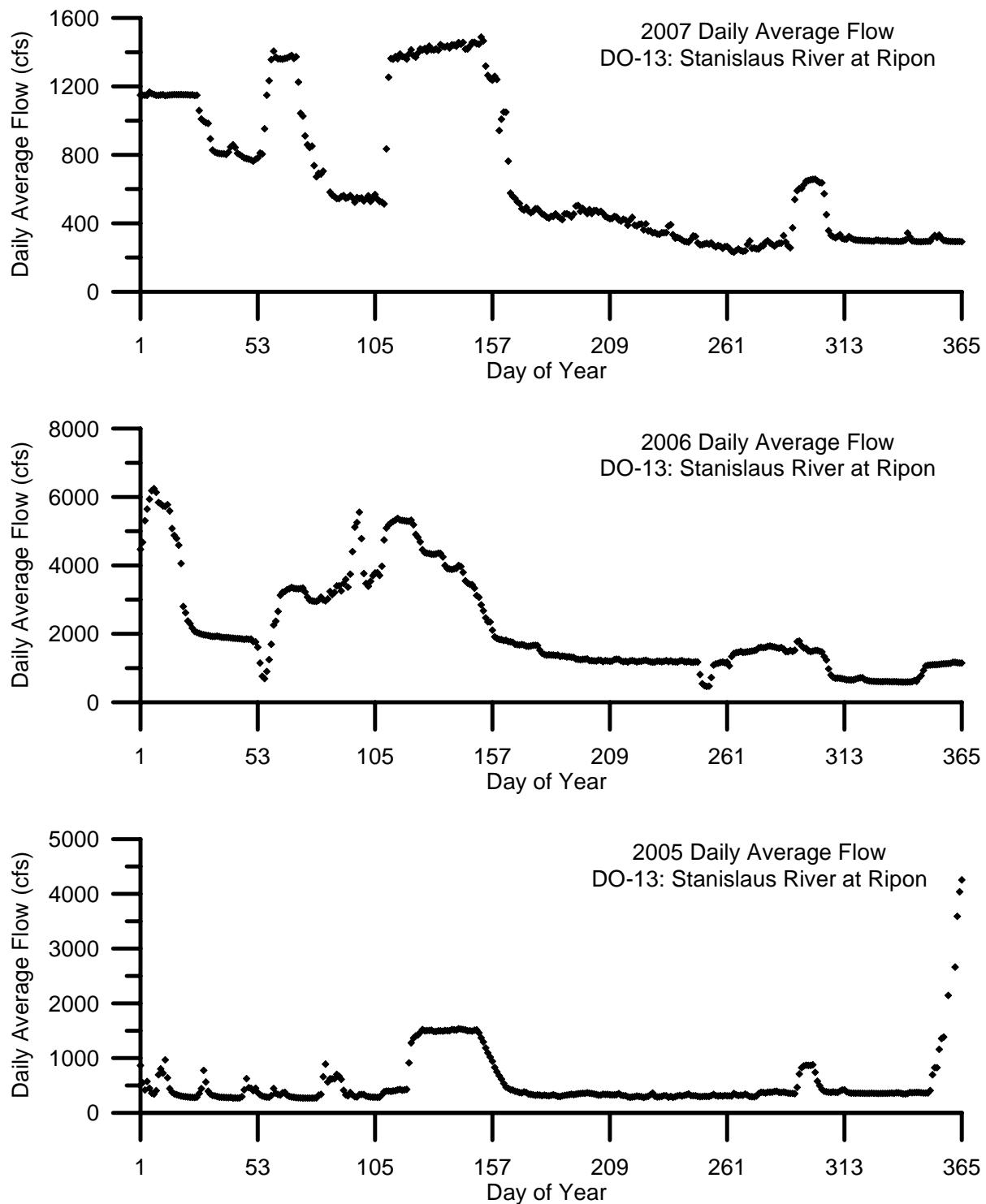


Figure 22: 2005 through 2007 flow plot for DO-13 Stanislaus River at Ripon

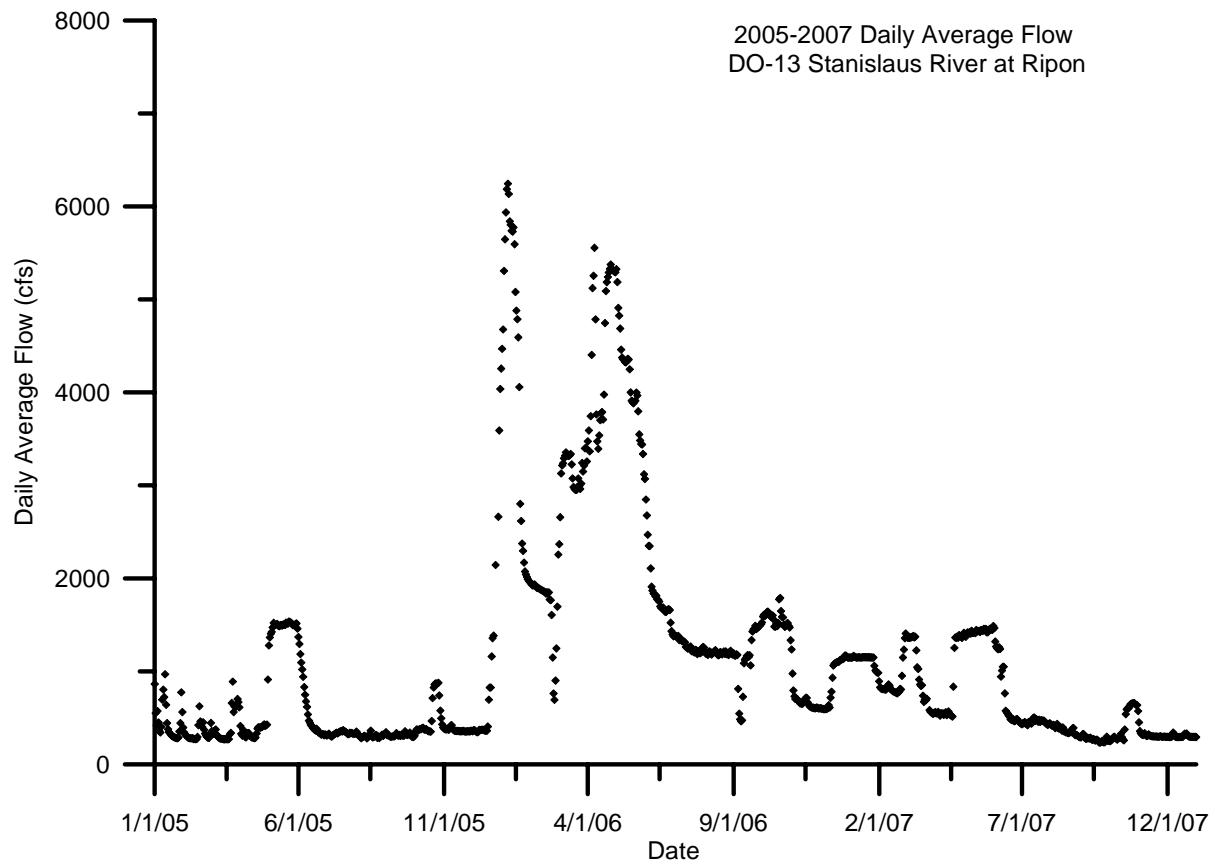


Figure 23: 2005 through 2007 flow plots for DO-15 Tuolumne River at Modesto

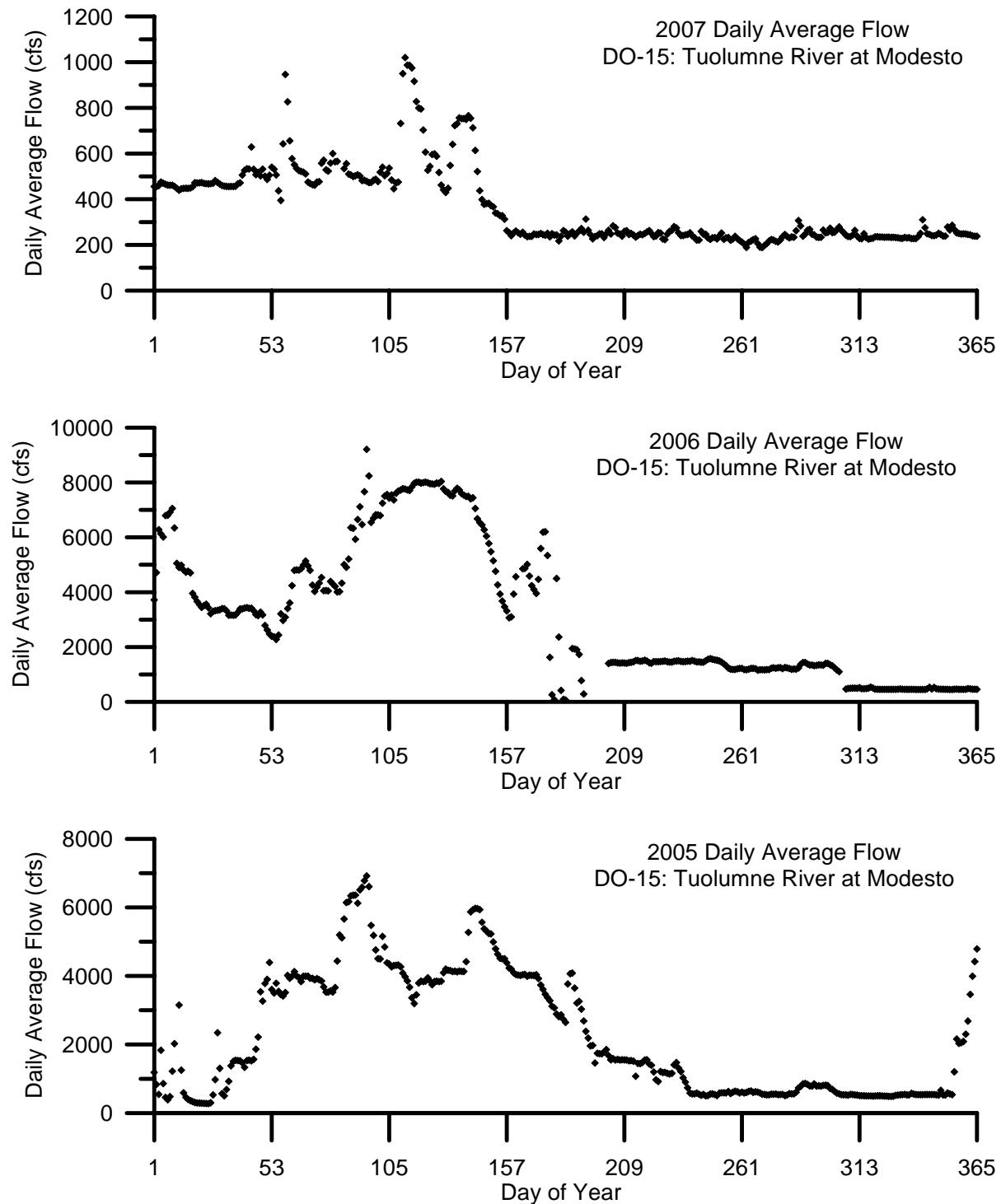


Figure 24: 2005 through 2007 flow plot for DO-15 Tuolumne River at Modesto

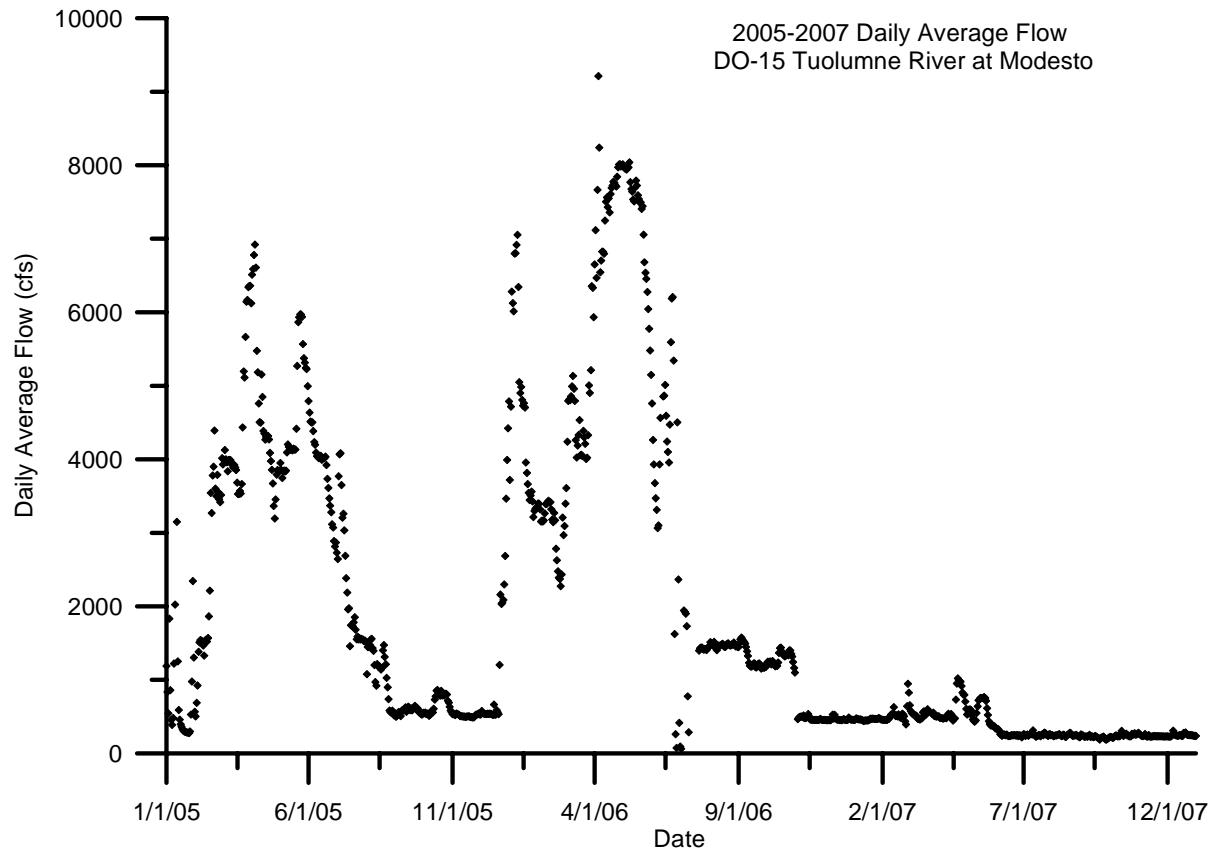


Figure 25: 2005 through 2007 flow plots for DO-17 Merced River near Stevinson

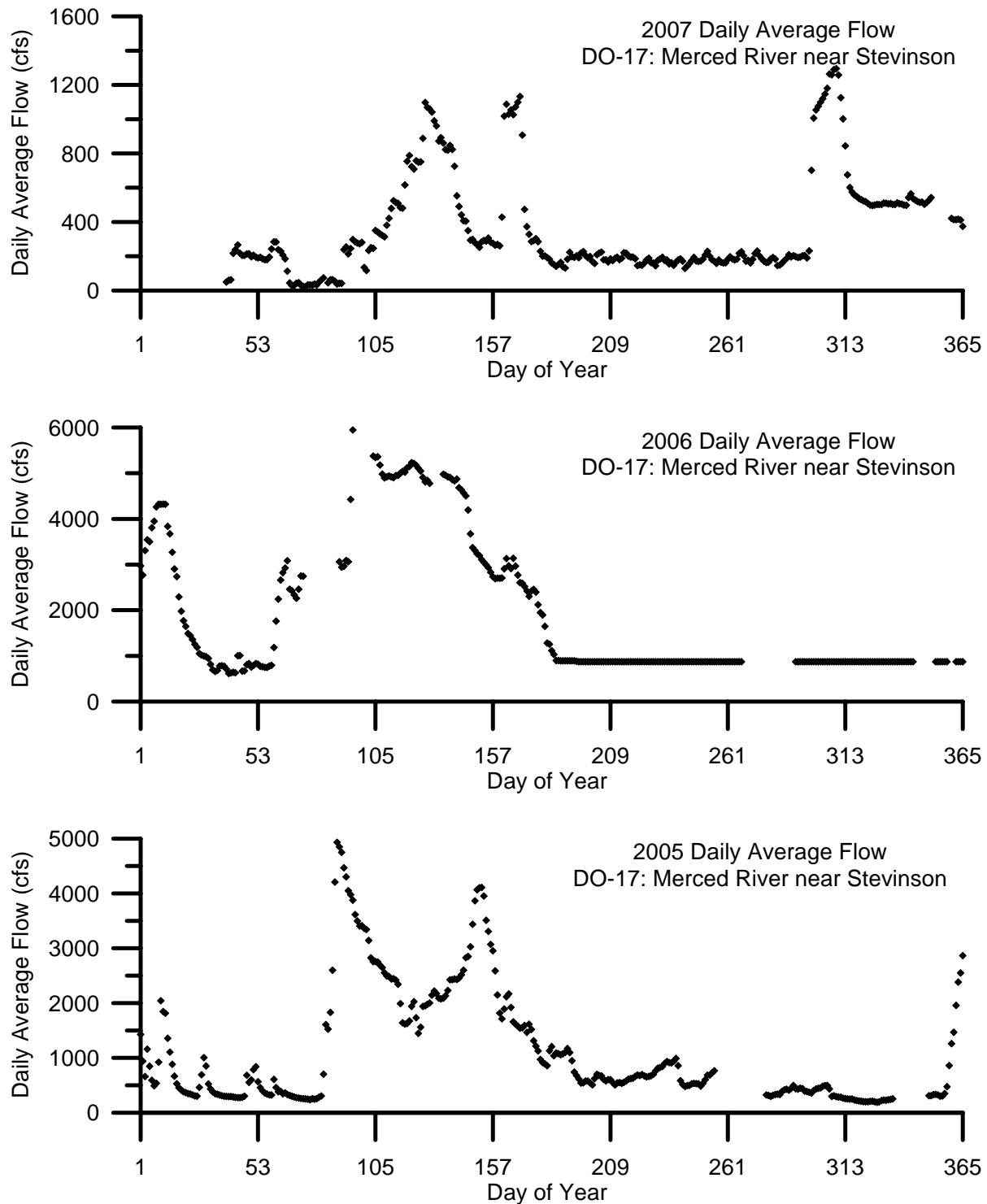


Figure 26: 2005 through 2007 flow plot for DO-17 Merced River near Stevinson

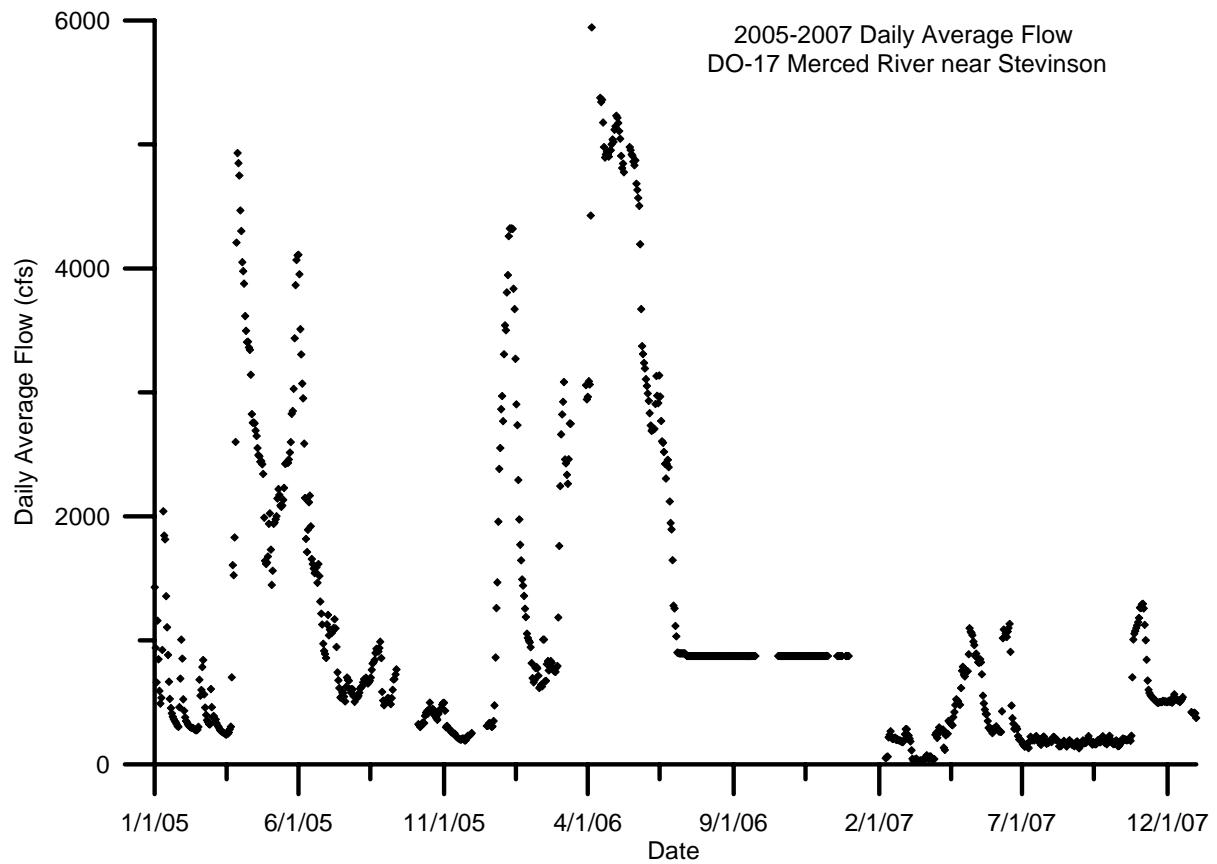


Figure 27: 2005 through 2007 flow plots for DO-18 Mud Slough near Gustine

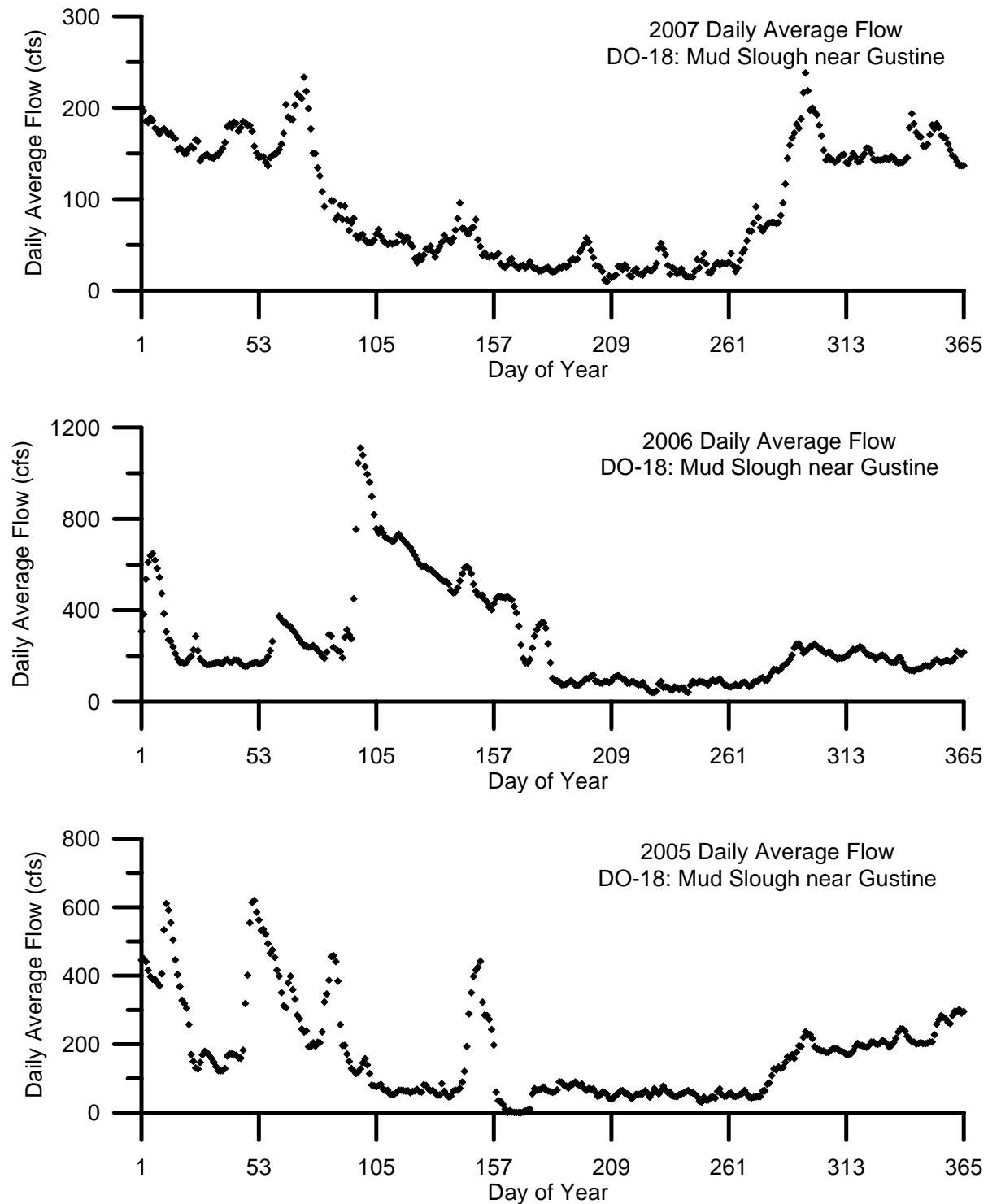


Figure 28: 2005 through 2007 flow plot for DO-18 Mud Slough near Gustine

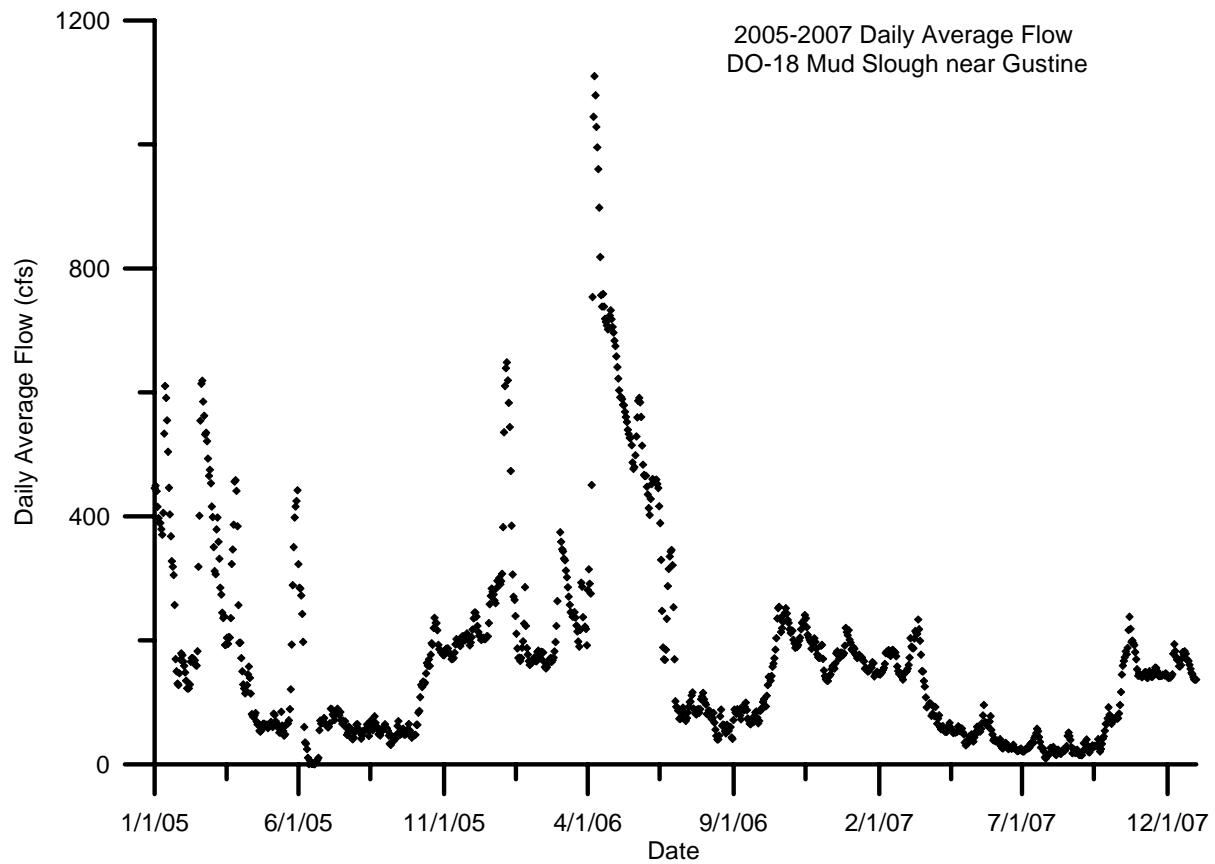


Figure 29: 2005 through 2007 flow plots for DO-19 Salt Slough at Lander Avenue

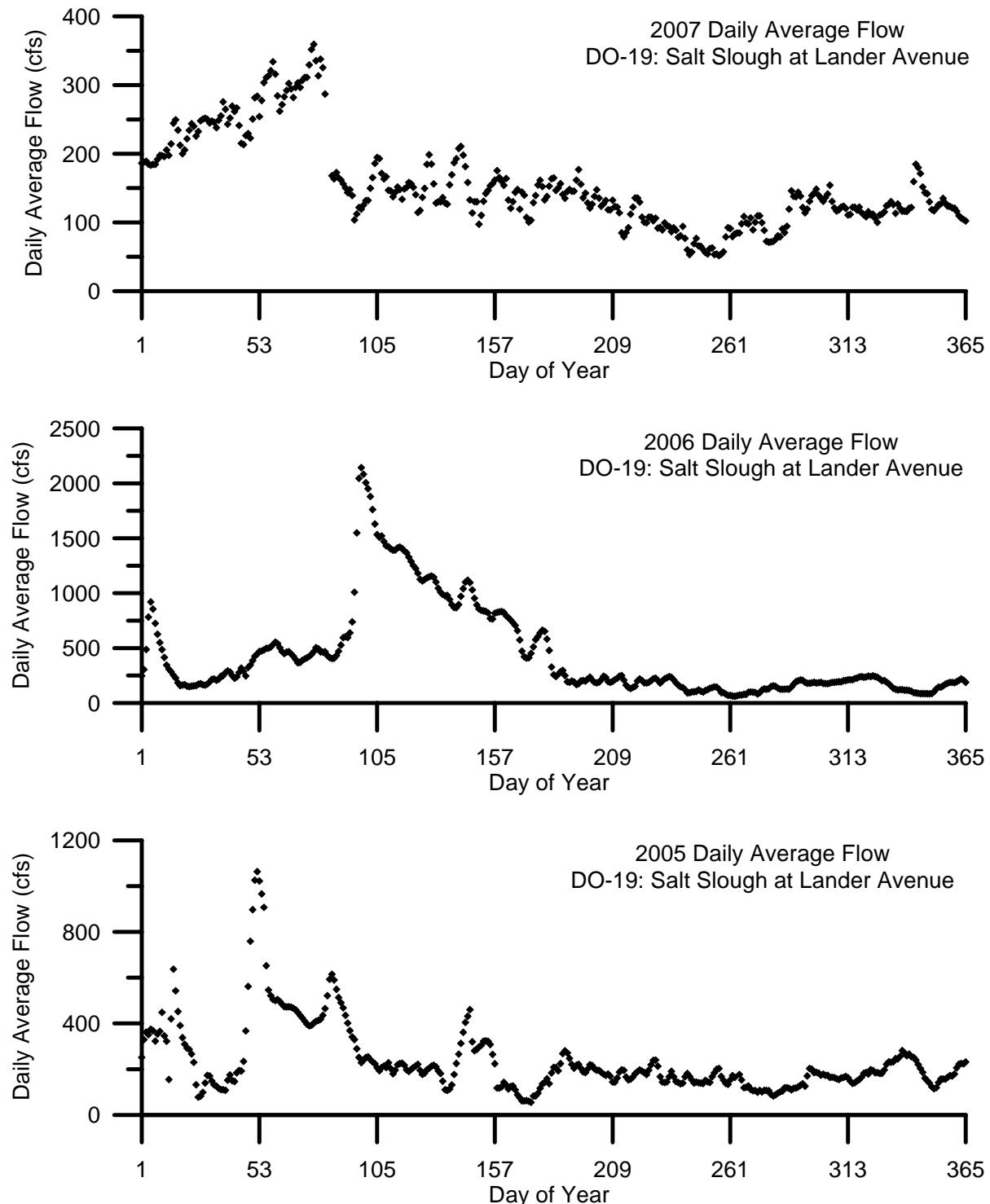


Figure 30: 2005 through 2007 flow plot for DO-19 Salt Slough at Lander Avenue

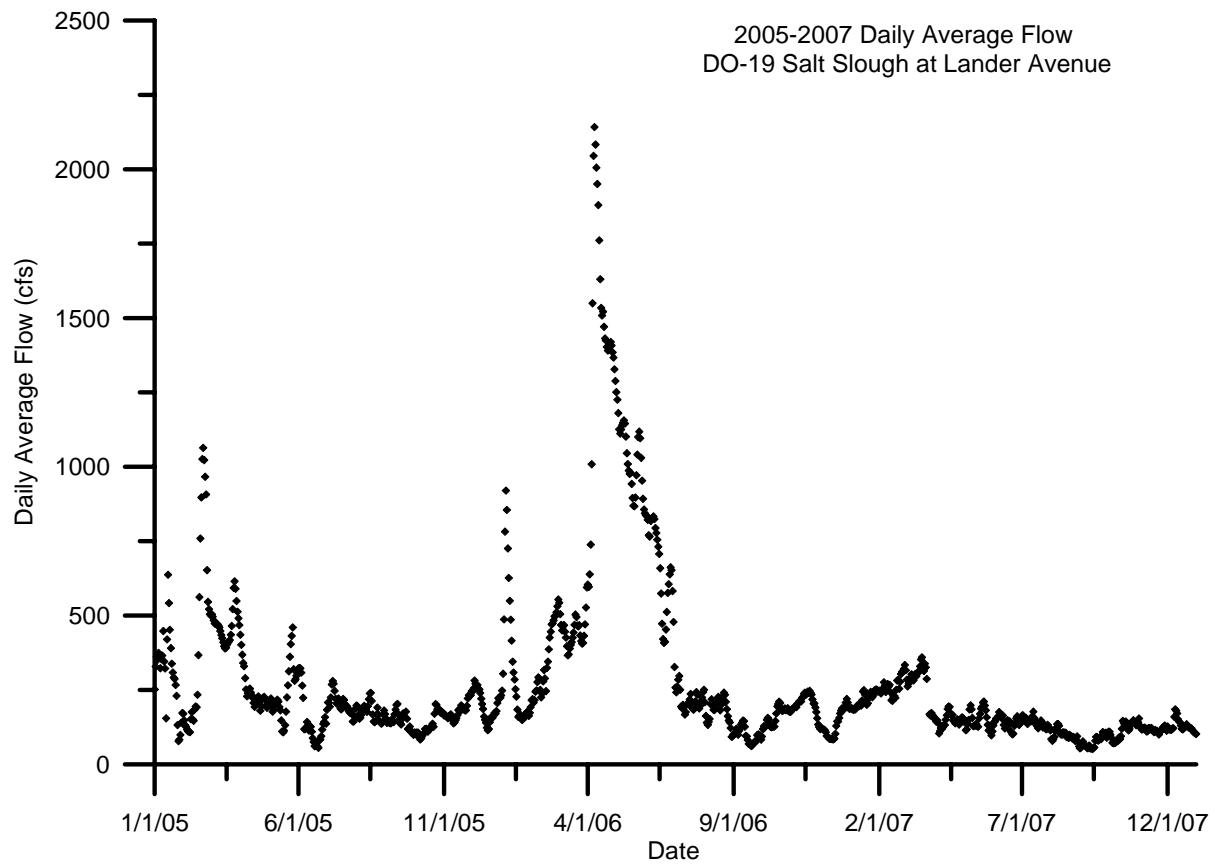


Figure 31: 2005 through 2007 flow plots for DO-20 Los Banos Creek

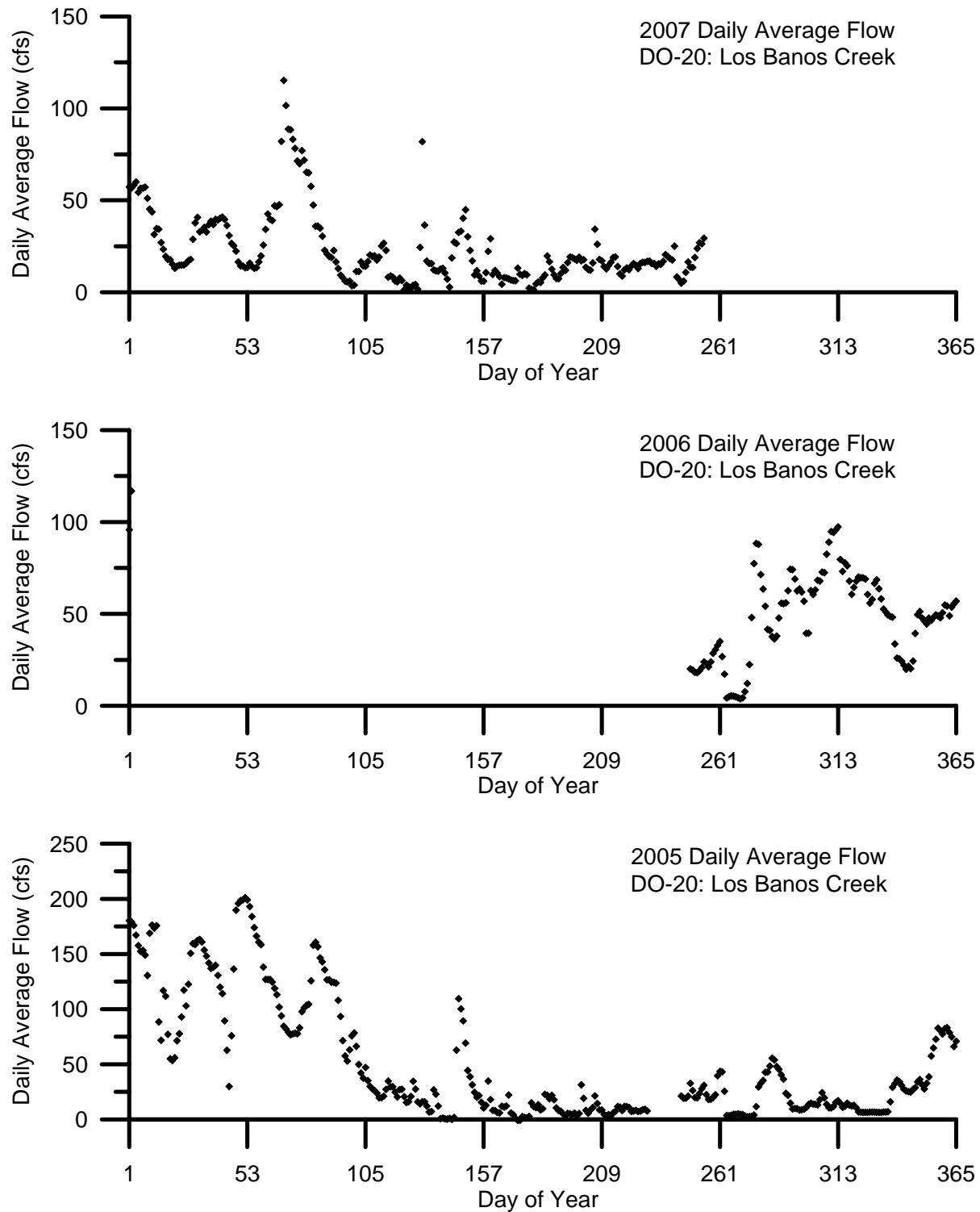


Figure 32: 2005 through 2007 flow plot for DO-20 Los Banos Creek

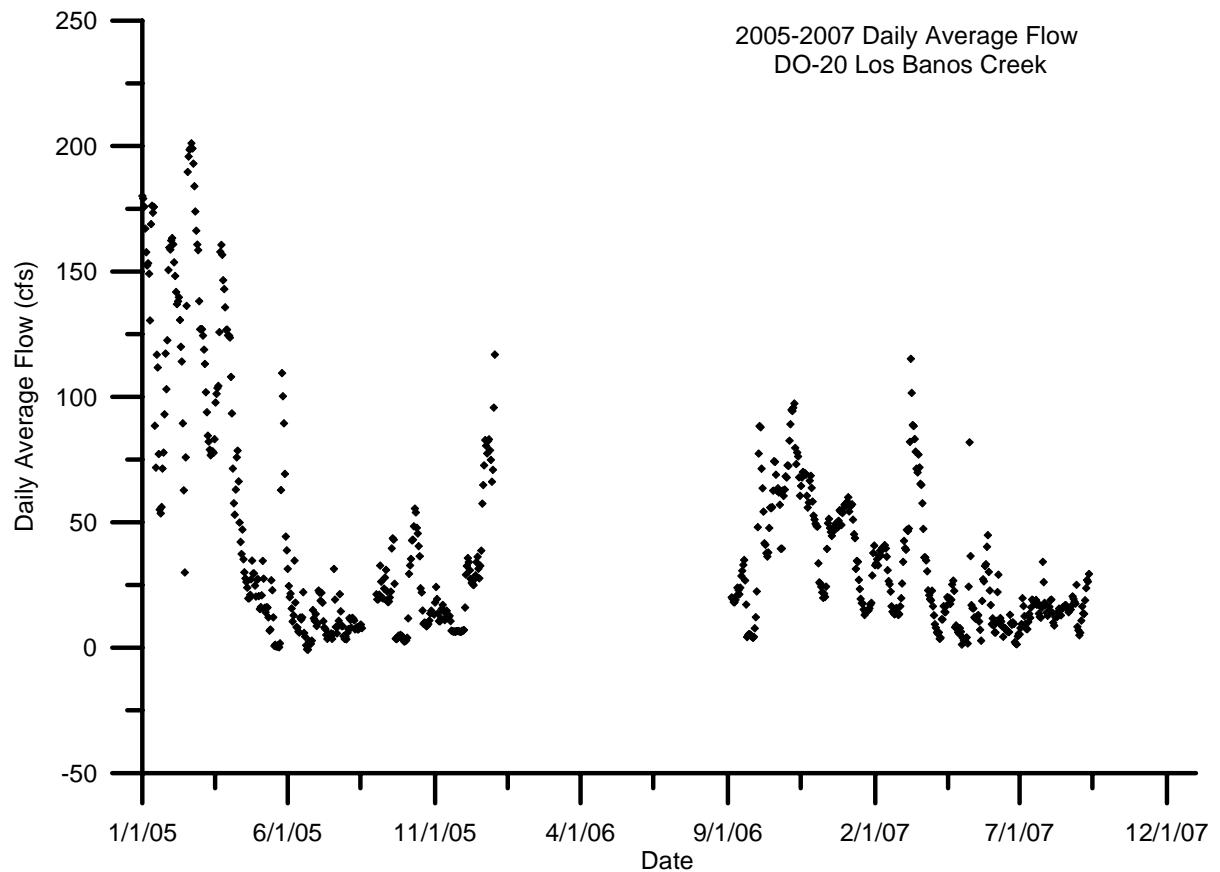


Figure 33: 2005 through 2007 flow plots for DO-21 Orestimba Creek at River Rd

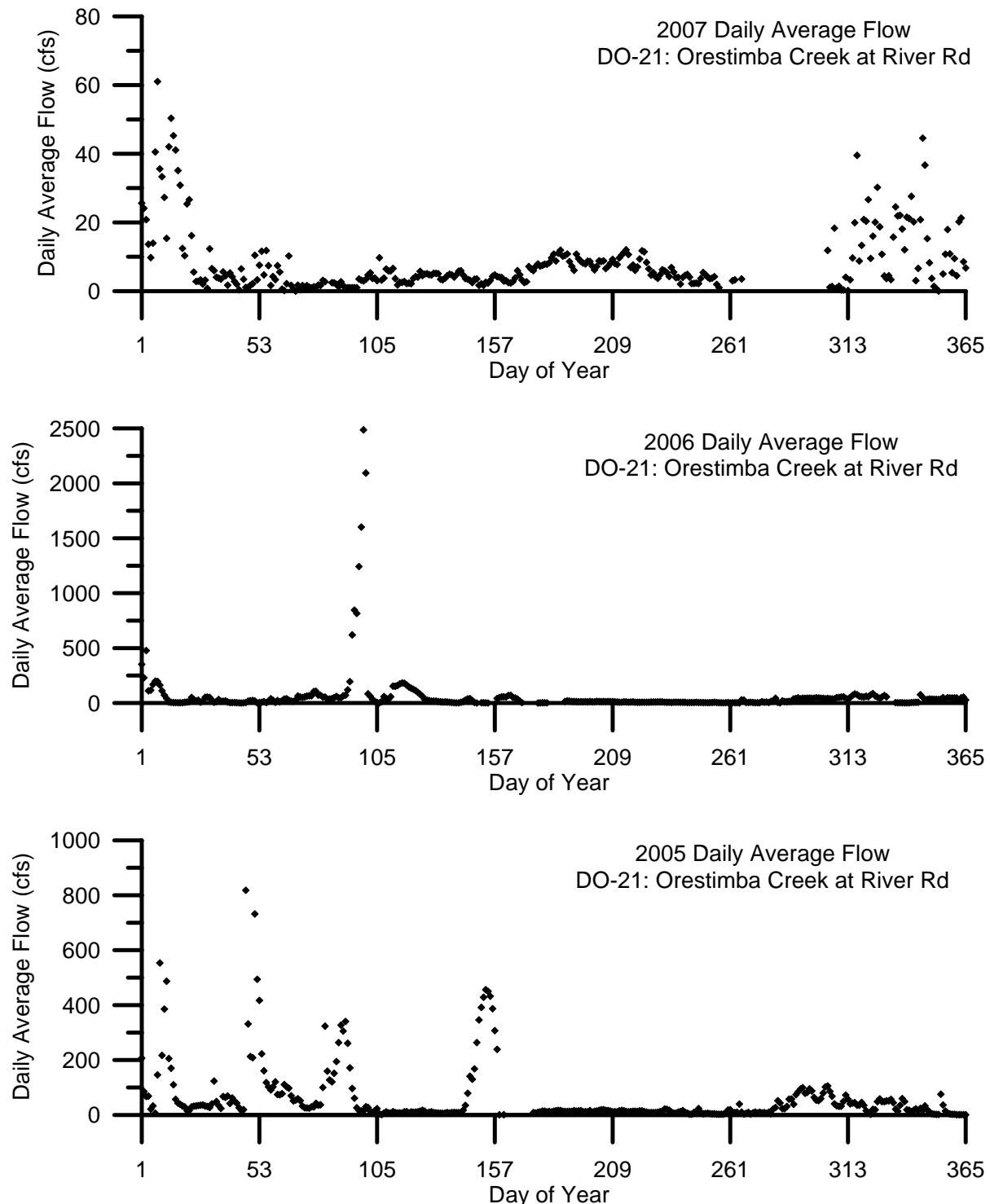


Figure 34: 2005 through 2007 flow plot for DO-21 Orestimba Creek at River Rd

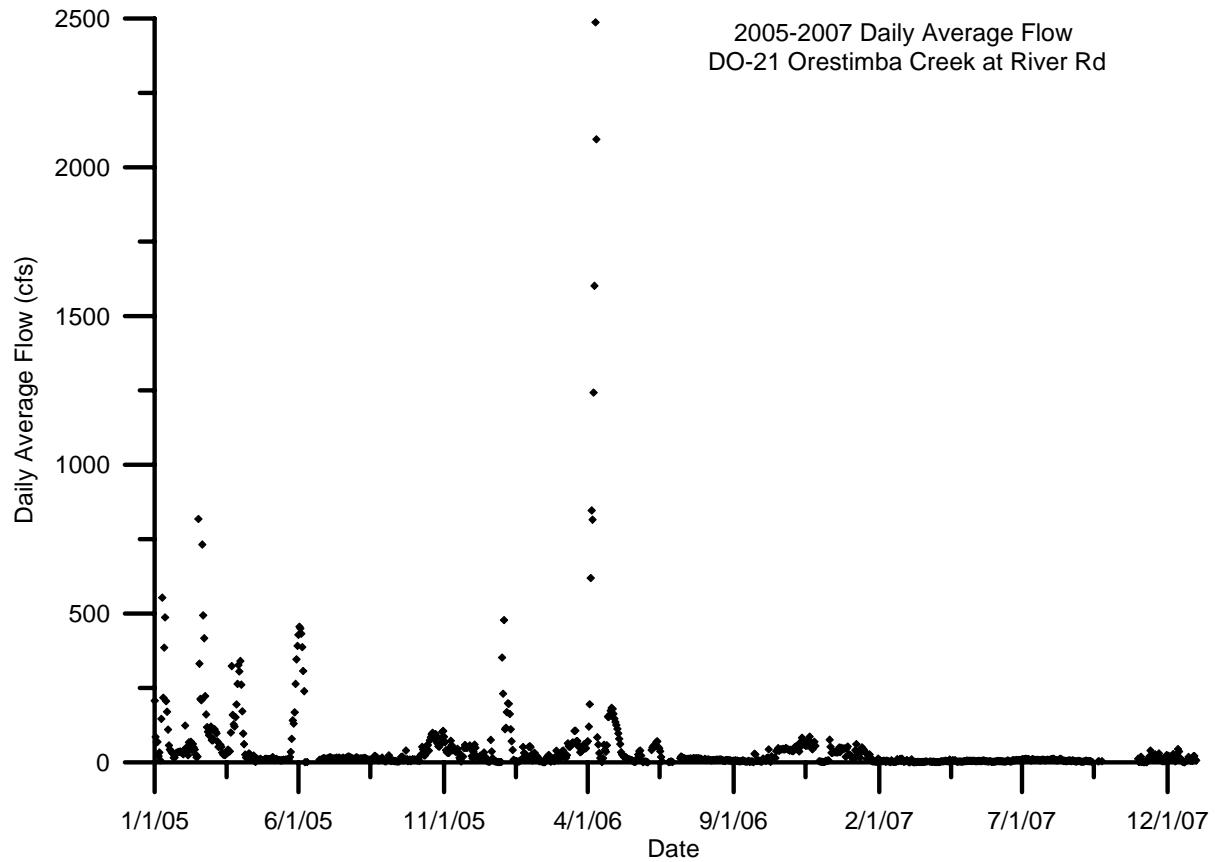


Figure 35: 2005 through 2007 flow plots for DO-22 MID Lateral 4 to SJR

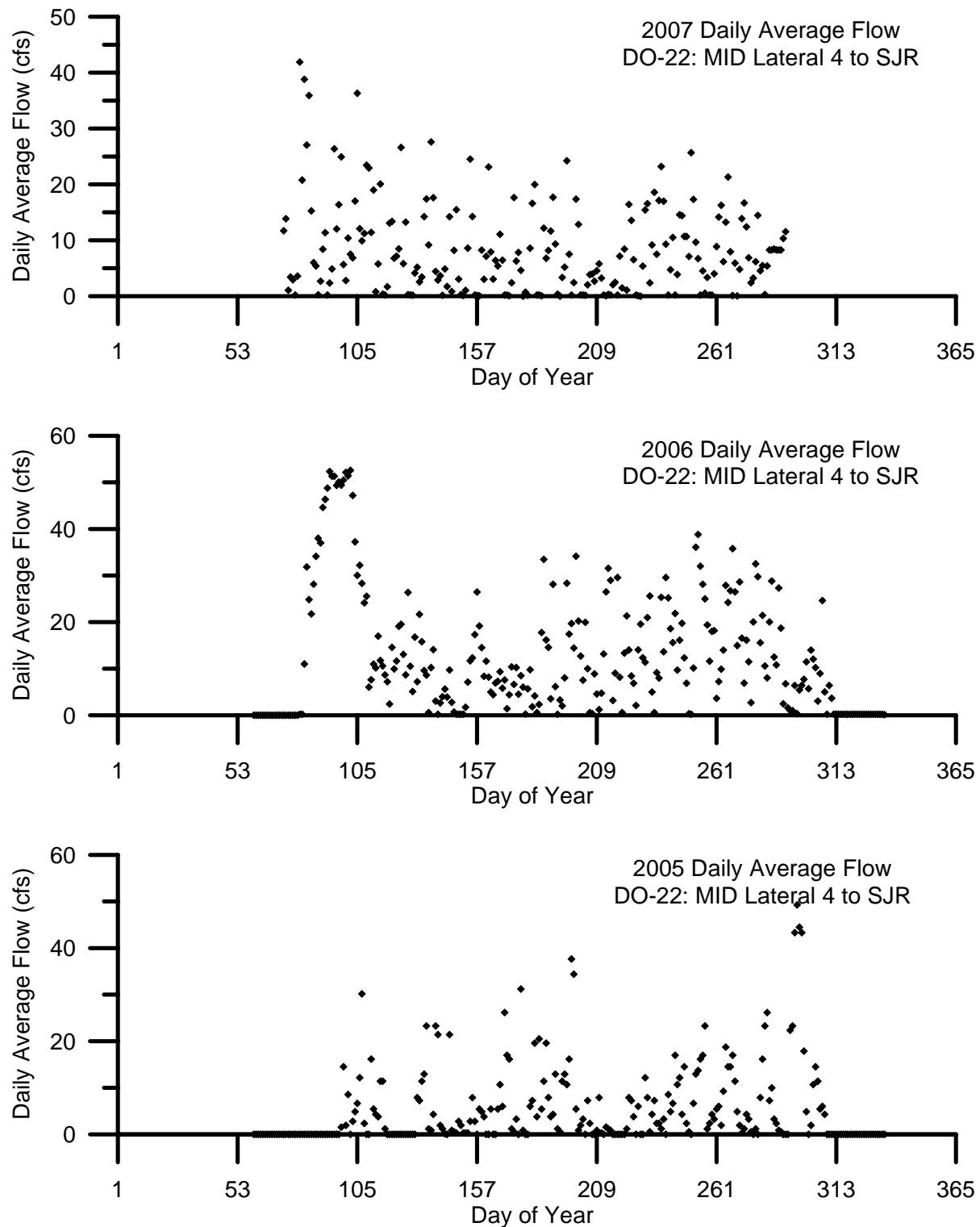


Figure 36: 2005 through 2007 flow plot for DO-22 MID Lateral 4 to SJR

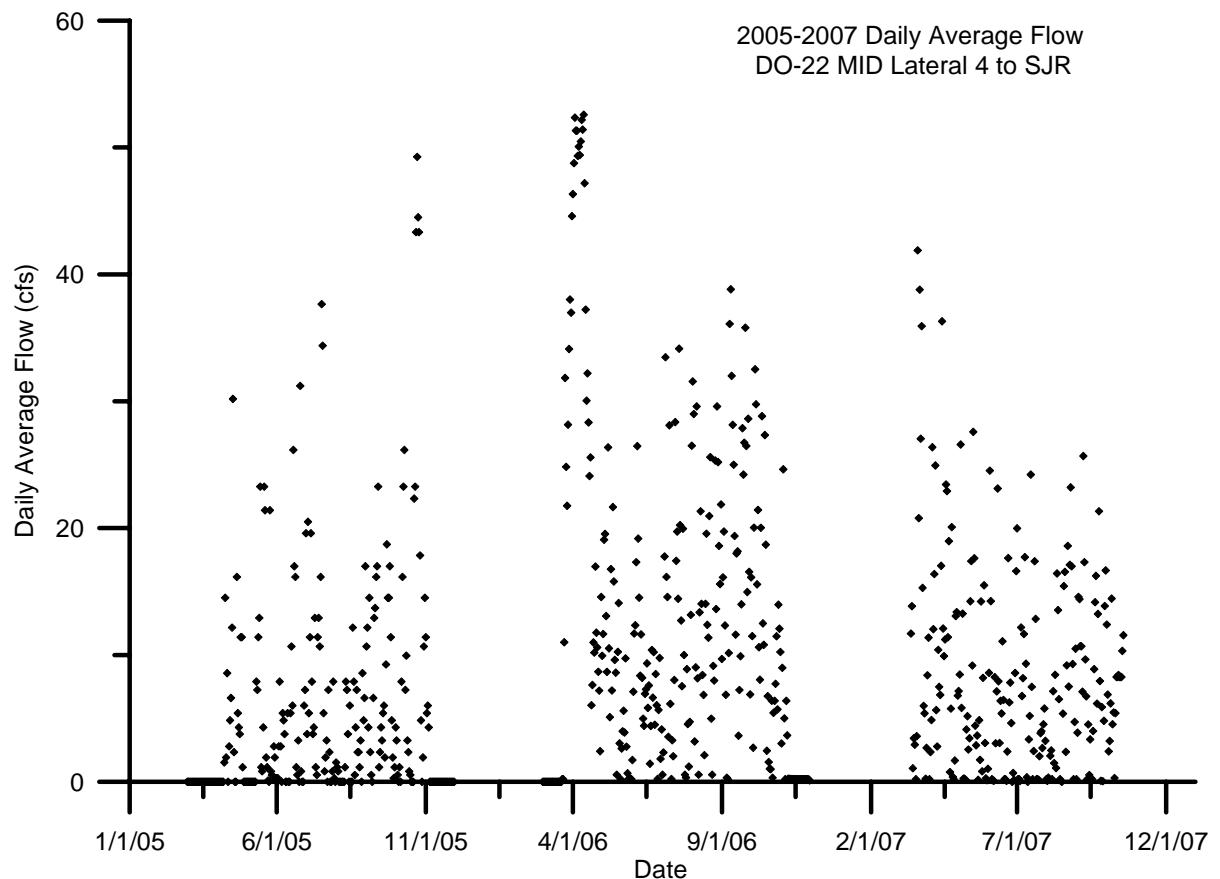


Figure 37: 2005 through 2007 flow plots for DO-23 MID Lateral 5 to Tuolumne

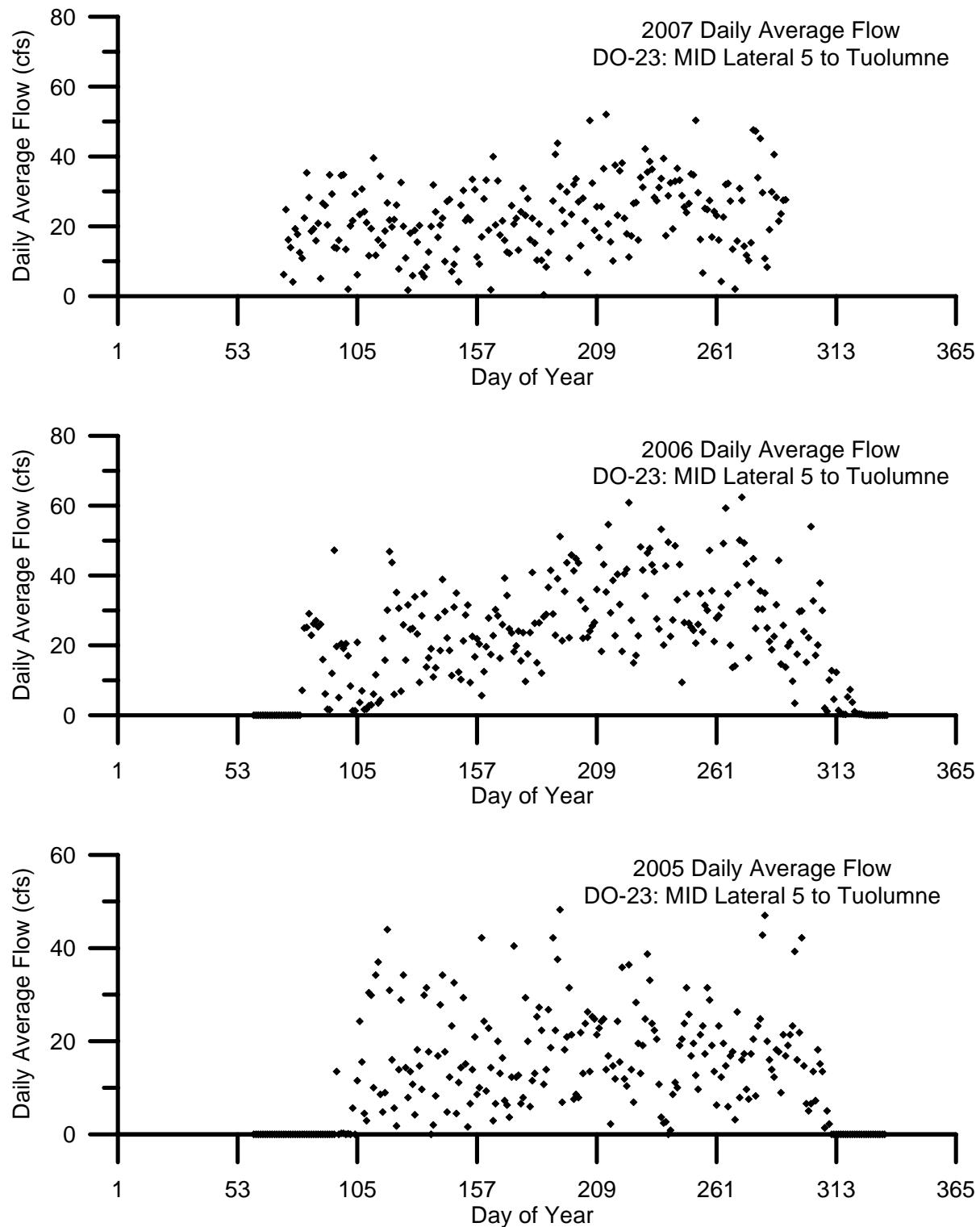


Figure 38: 2005 through 2007 flow plot for DO-23 MID Lateral 5 to Tuolumne

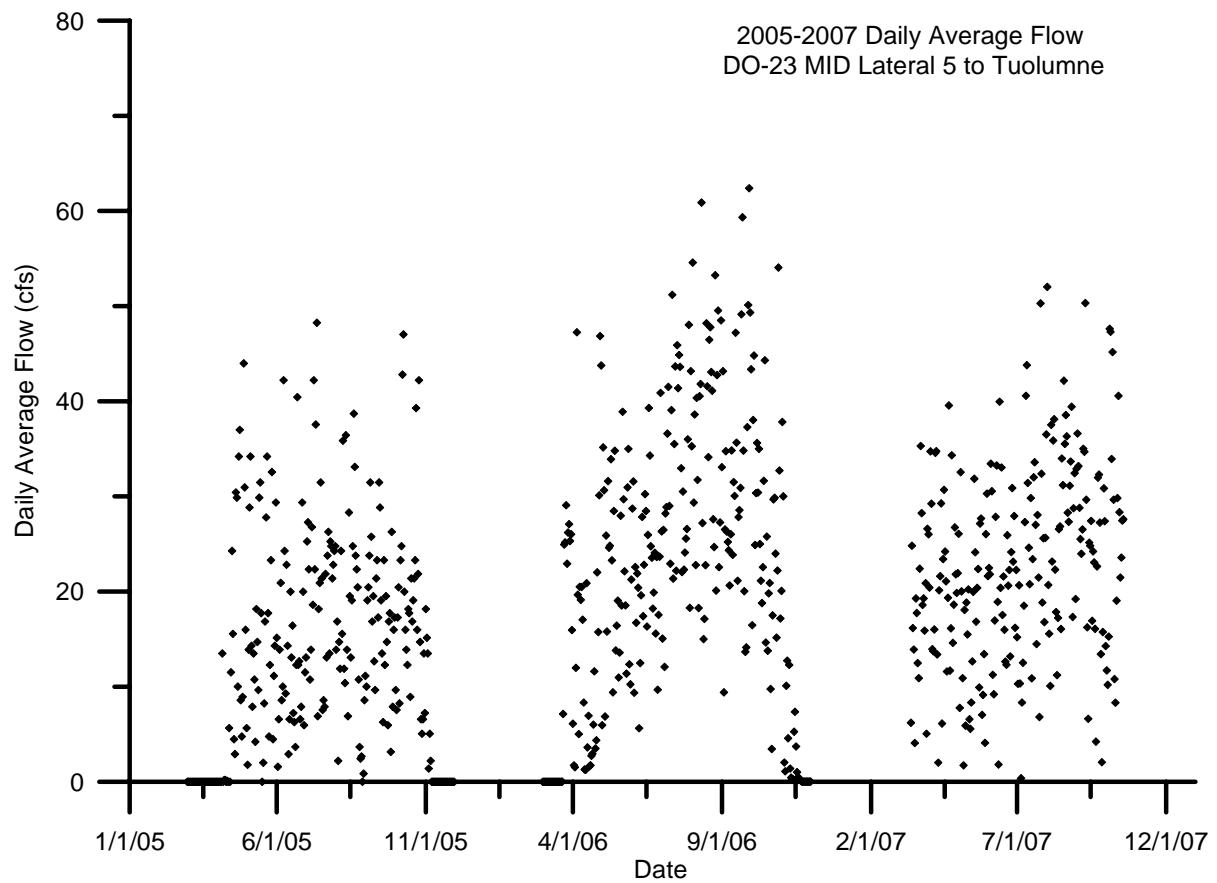


Figure 39: 2005 through 2007 flow plots for DO-24 MID Lateral 6 to Stanislaus River

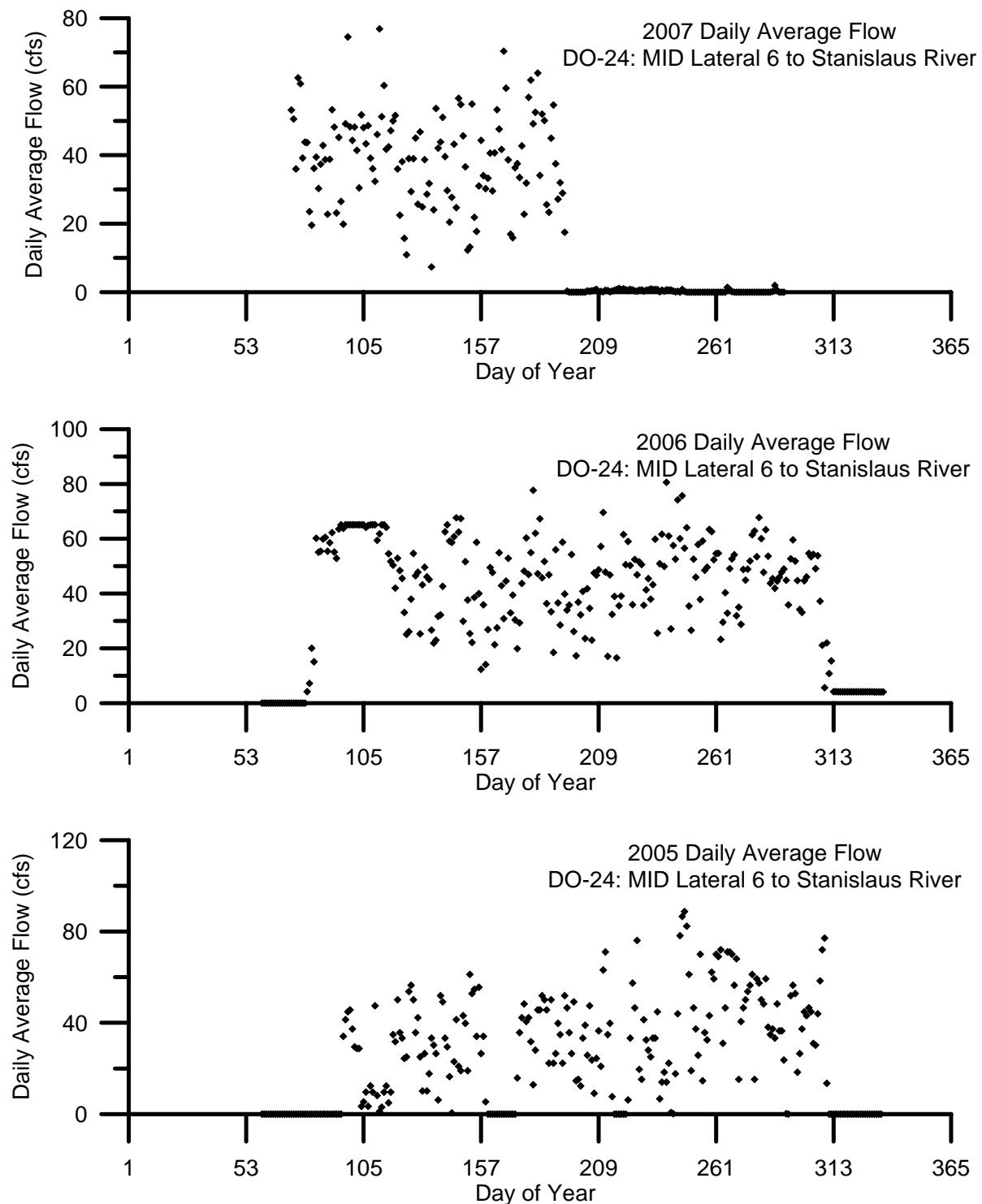


Figure 40: 2005 through 2007 flow plot for DO-24 MID Lateral 6 to Stanislaus River

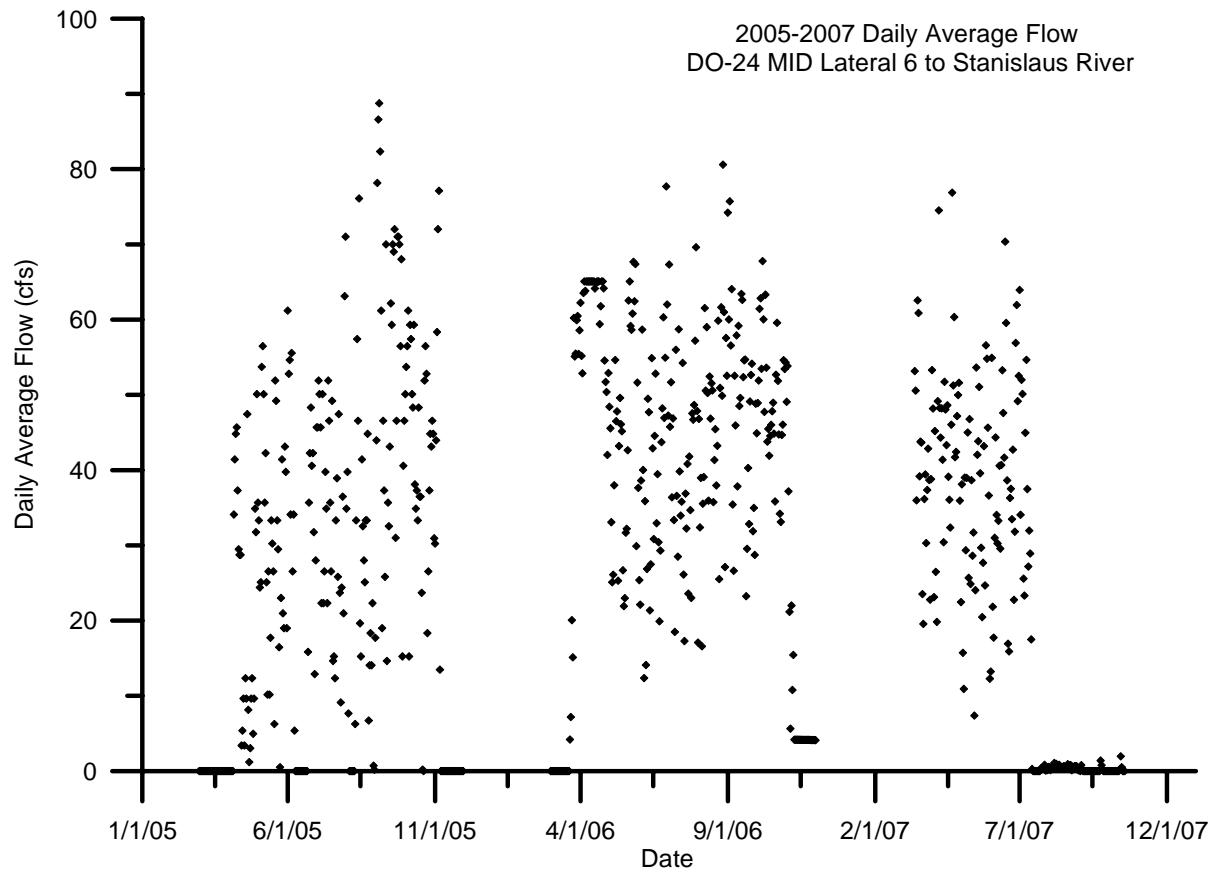


Figure 41: 2005 through 2007 flow plots for DO-25 MID Main Drain to Stanislaus River via Miller Lake

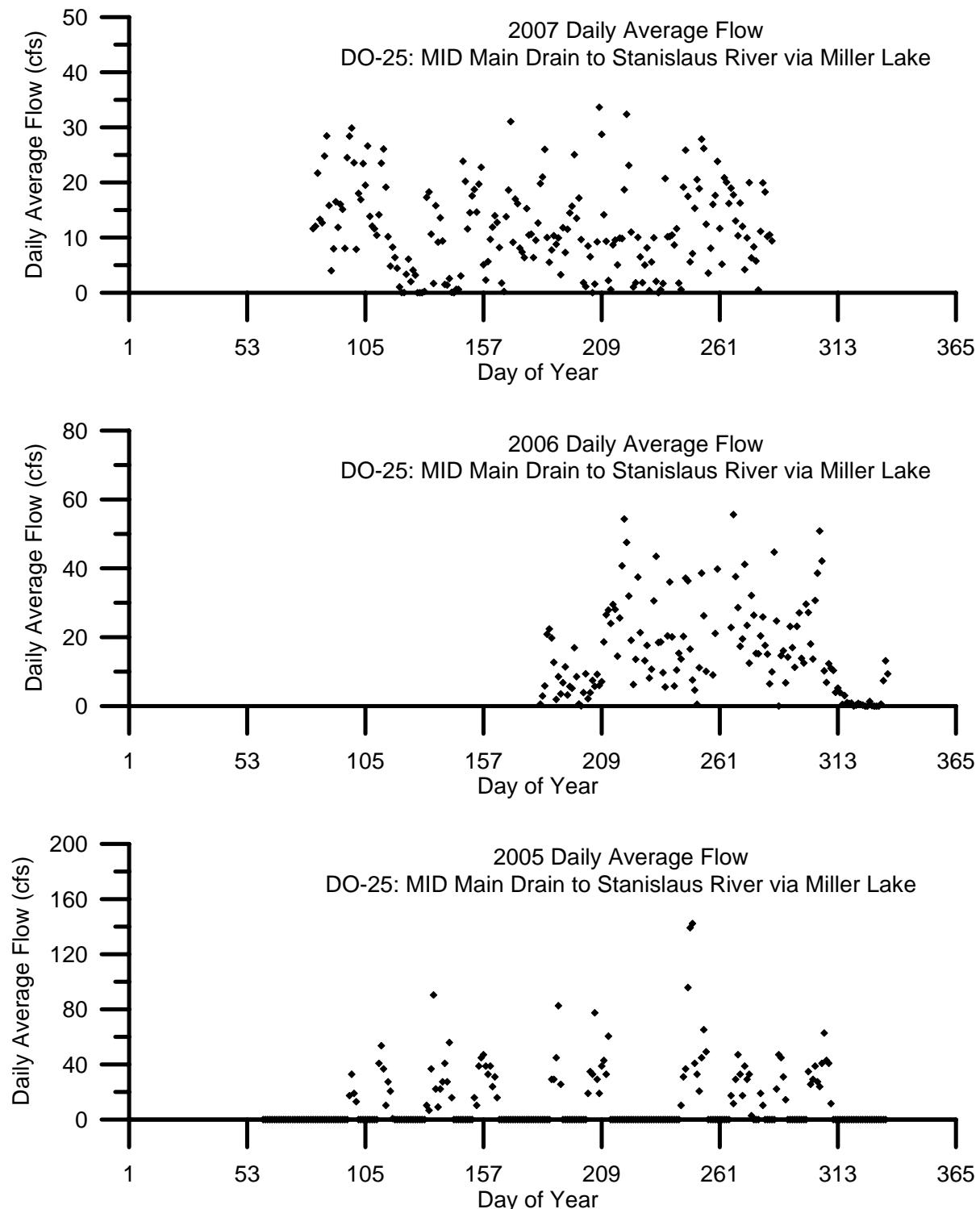


Figure 42: 2005 through 2007 flow plot for DO-25 MID Main Drain to Stanislaus River via Miller Lake

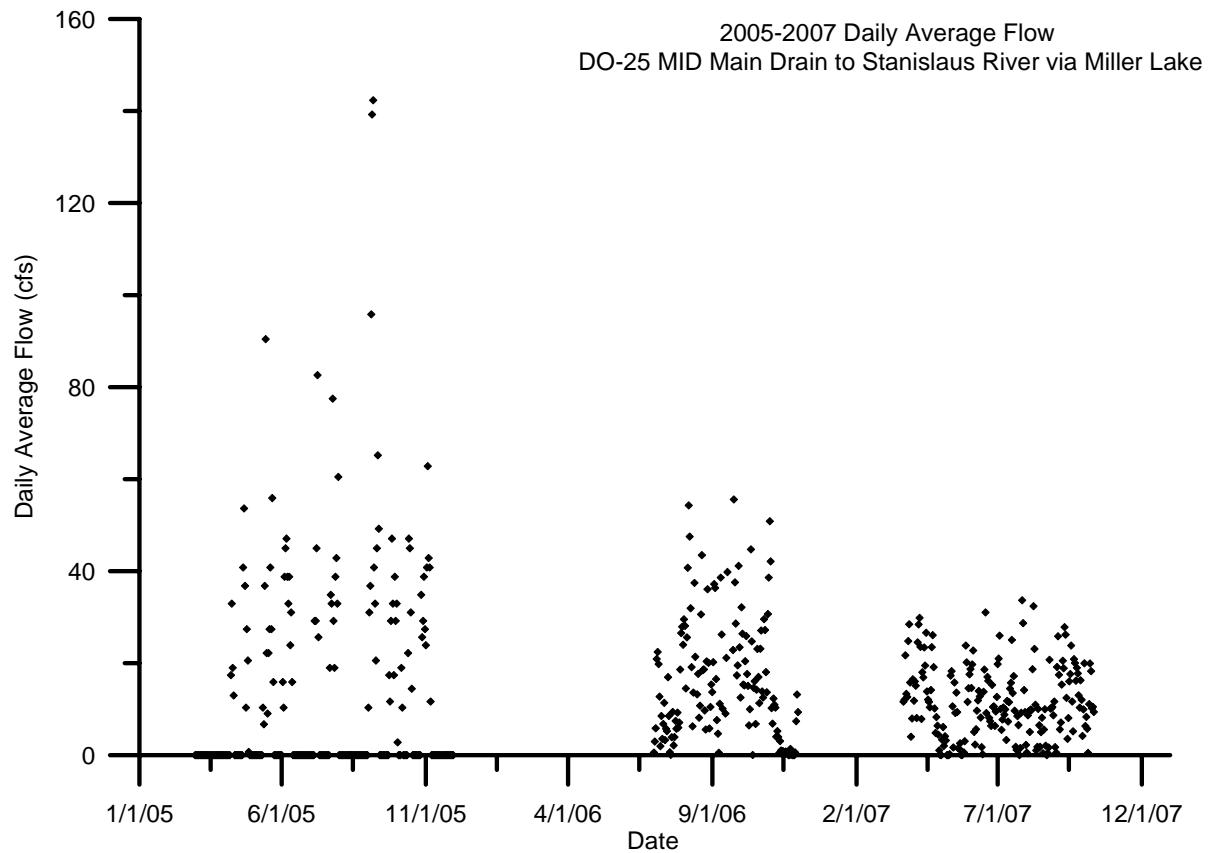


Figure 43: 2005 through 2007 flow plots for DO-26 TID Highline Spill

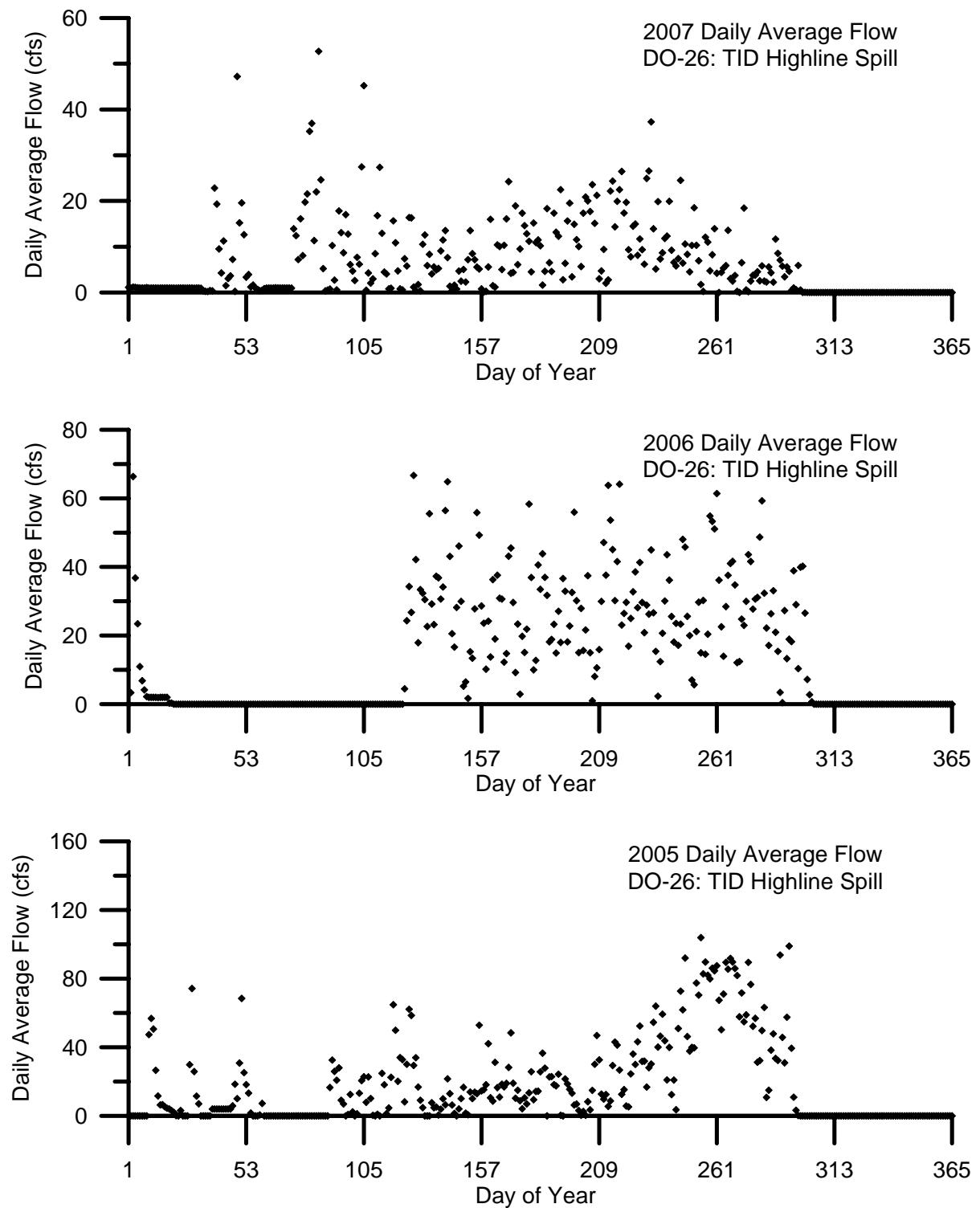


Figure 44: 2005 through 2007 flow plot for DO-26 TID Highline Spill

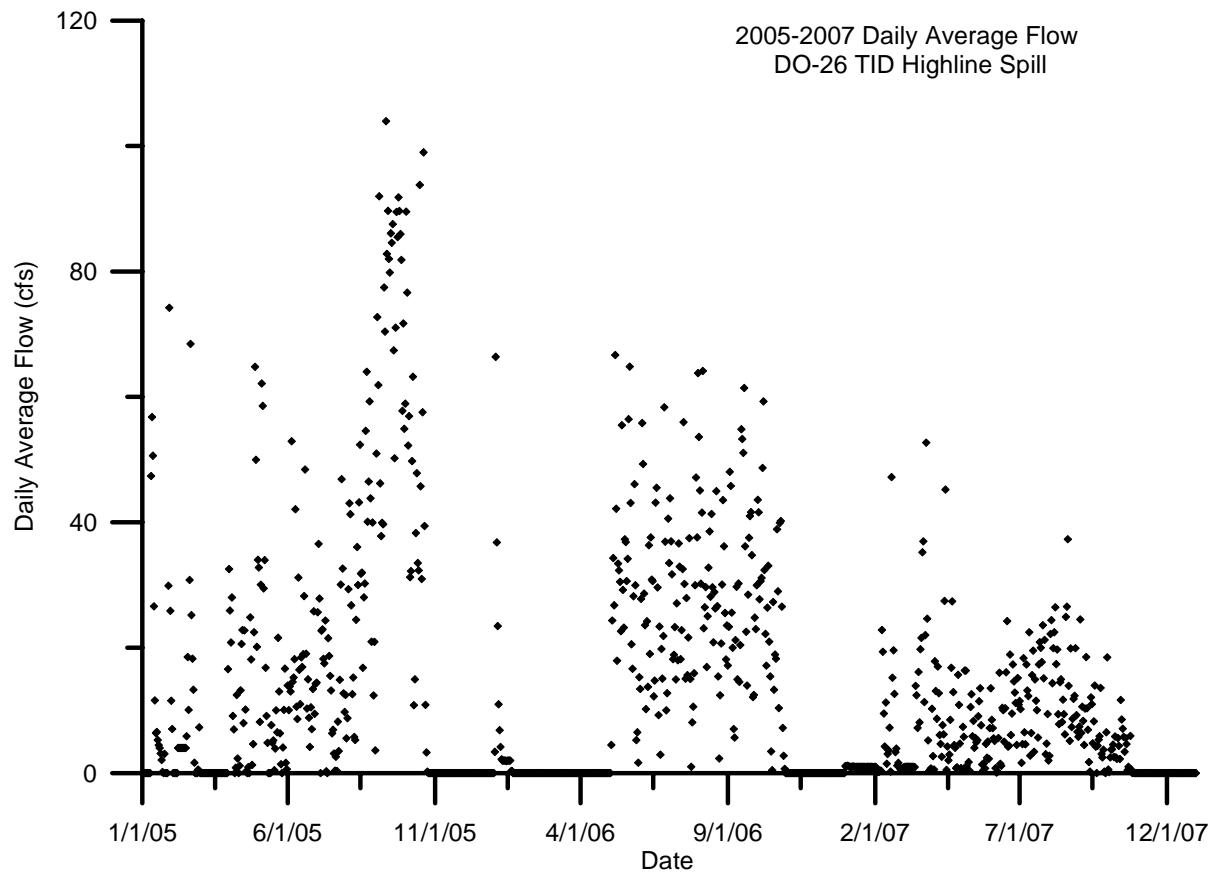


Figure 45: 2005 through 2007 flow plots for DO-27 TID Lateral 2

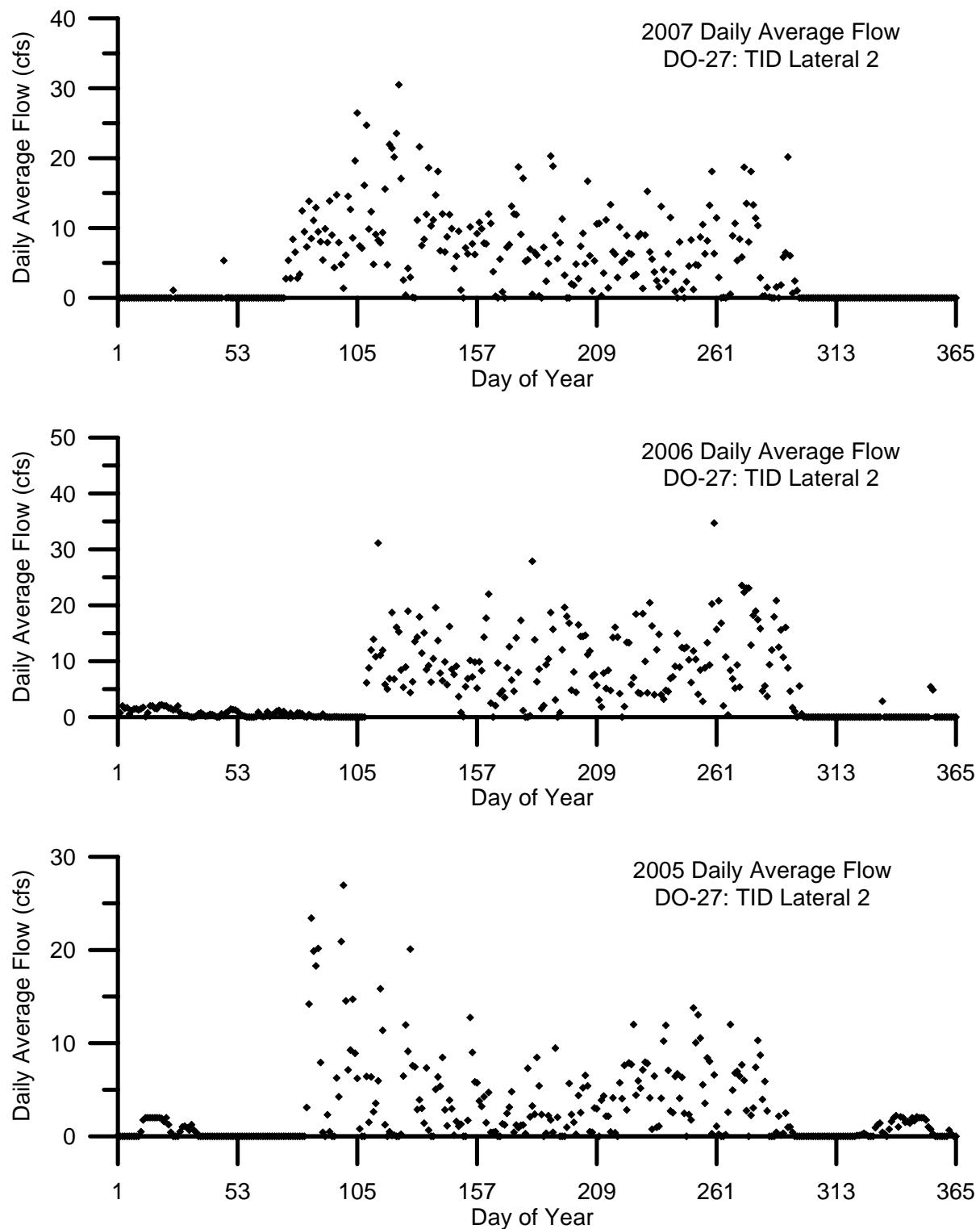


Figure 46: 2005 through 2007 flow plot for DO-27 TID Lateral 2

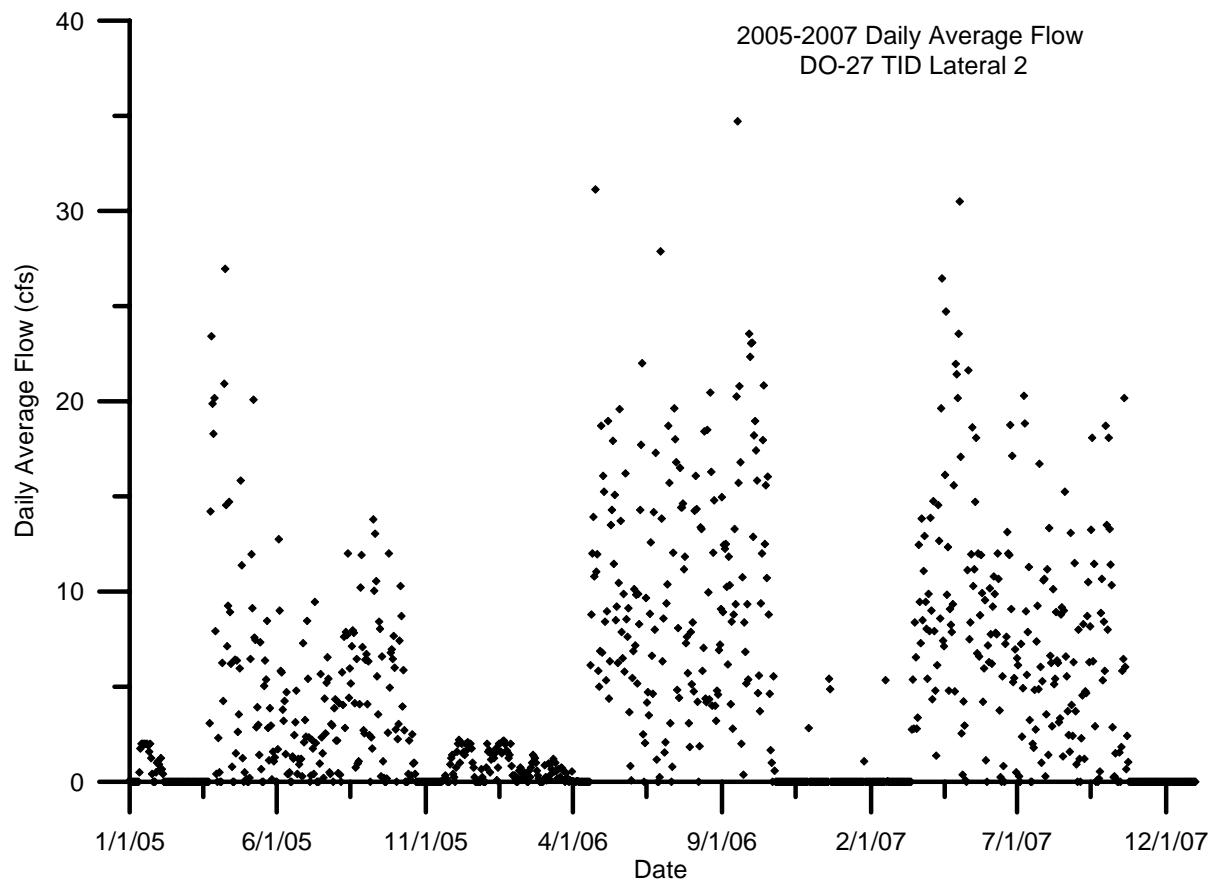


Figure 47: 2005 through 2007 flow plots for DO-28 TID Westport Drain

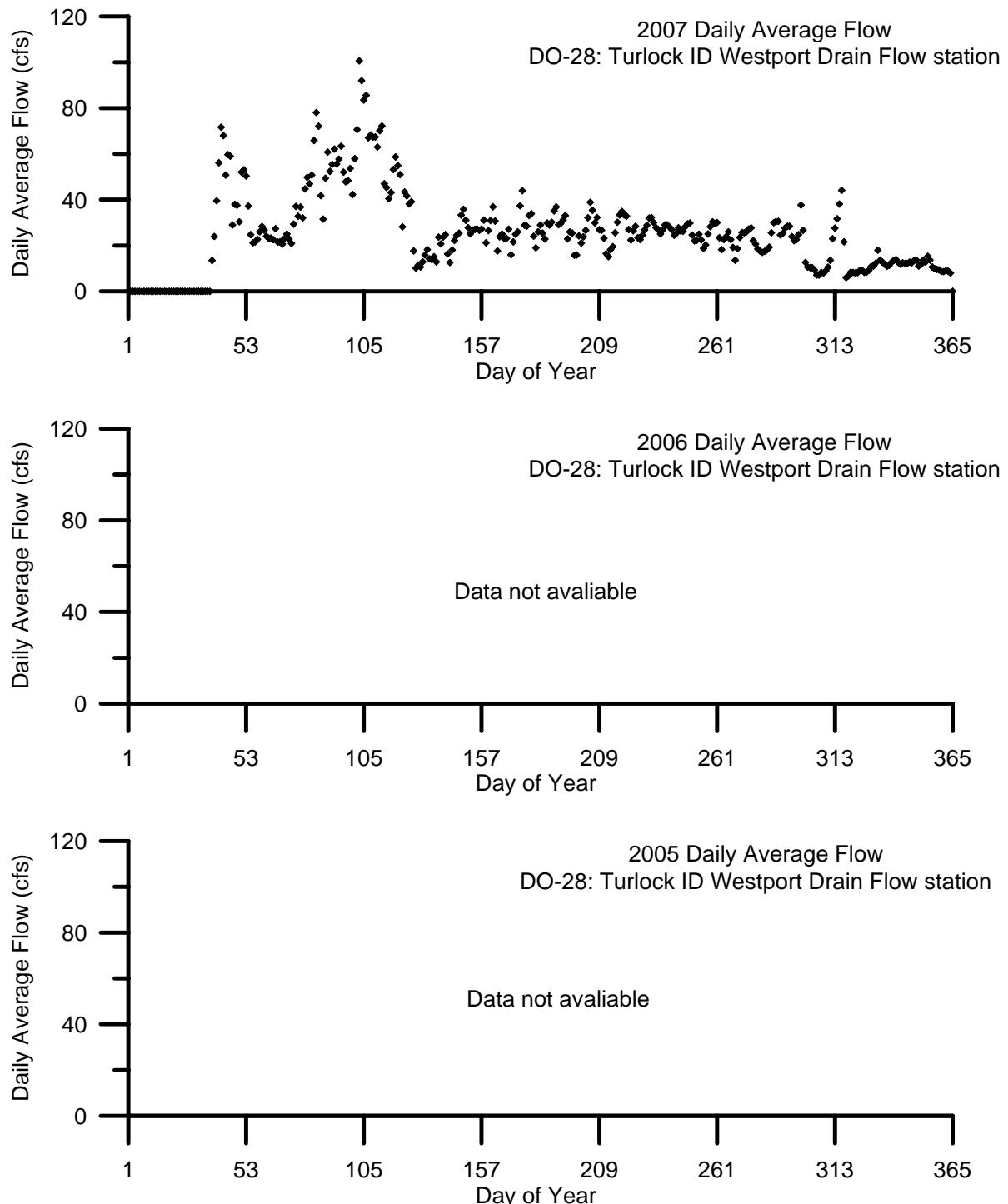


Figure 48: 2005 through 2007 flow plot for DO-28 TID Westport Drain

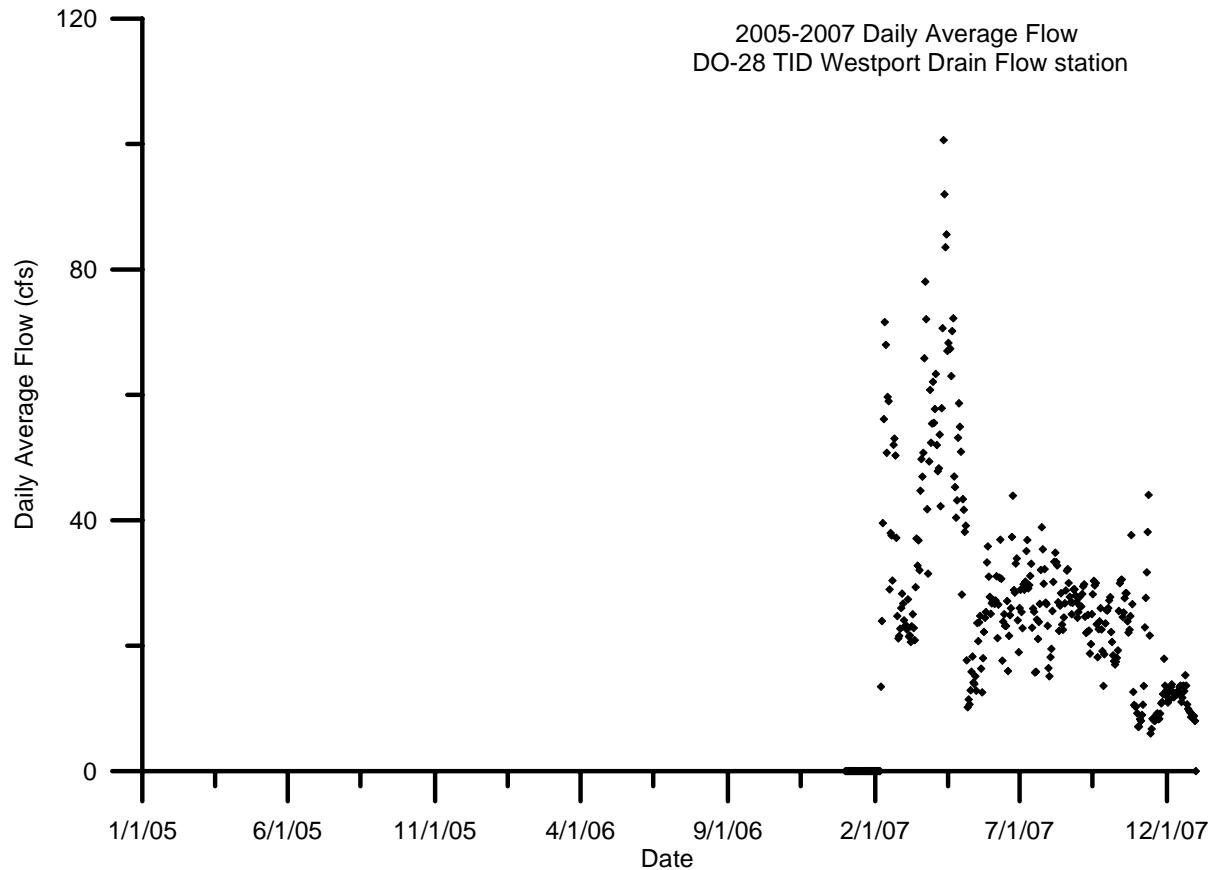


Figure 49: 2005 through 2007 flow plots for DO-29 TID Harding Drain

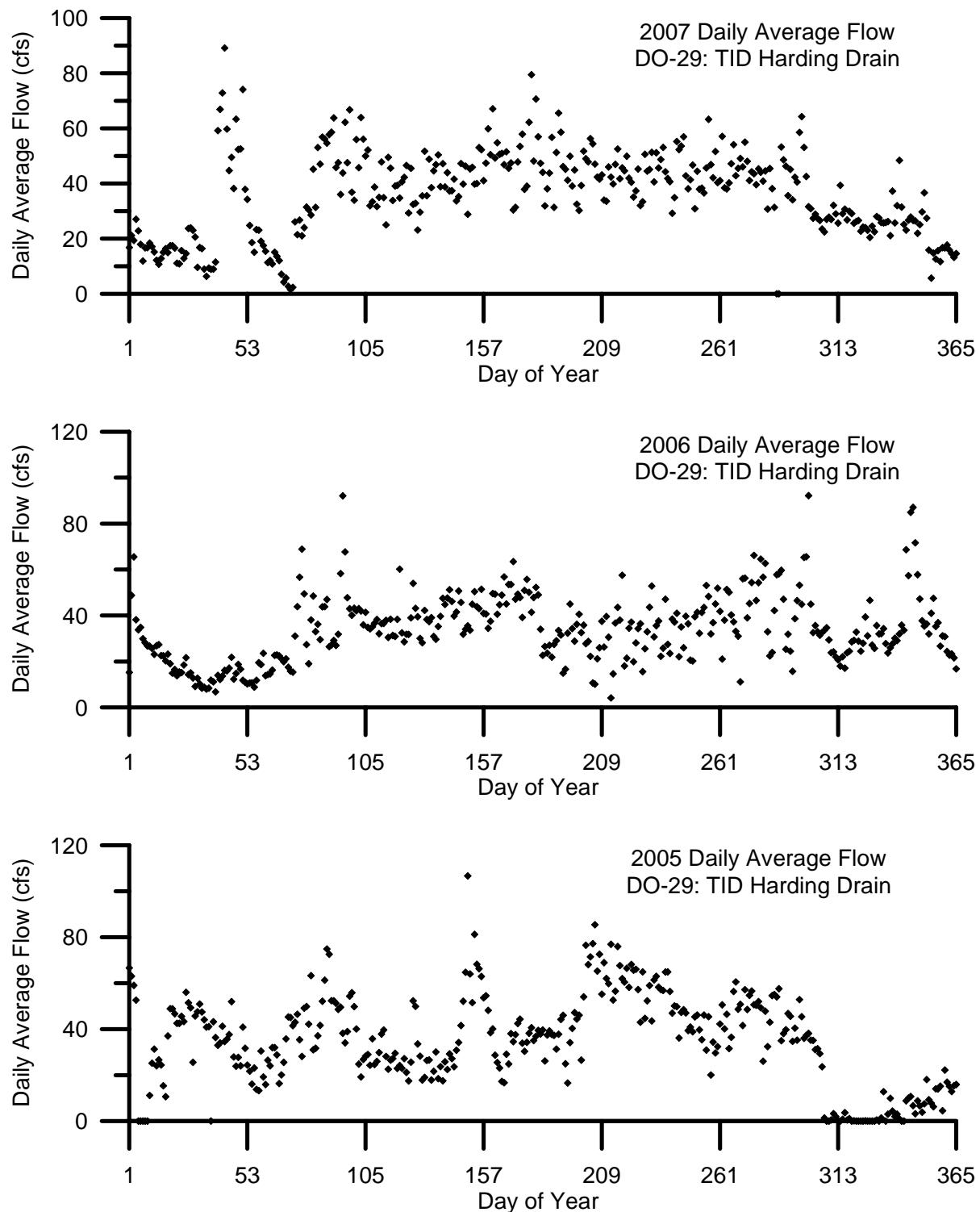


Figure 50: 2005 through 2007 flow plot for DO-29 TID Harding Drain

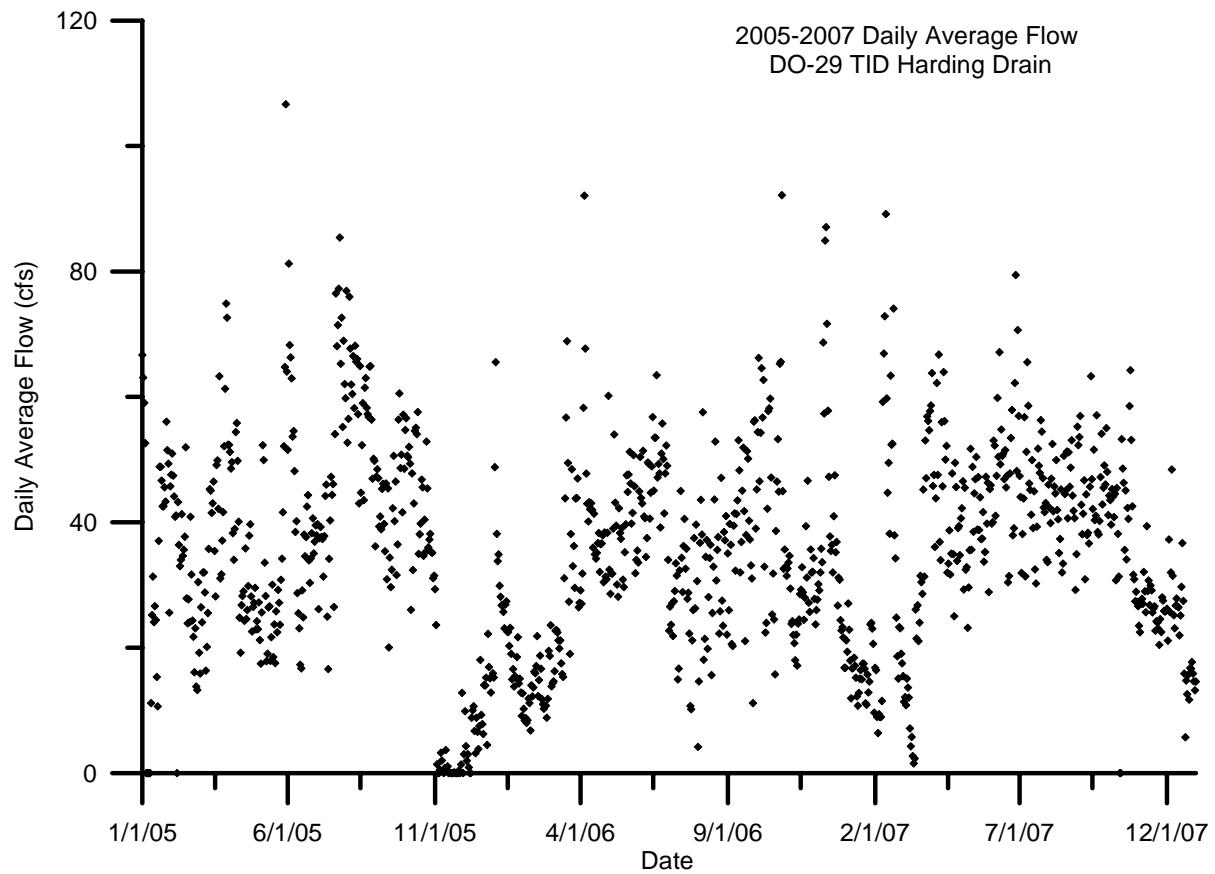


Figure 51: 2005 through 2007 flow plots for DO-30 TID Lateral 6 & 7 at Levee

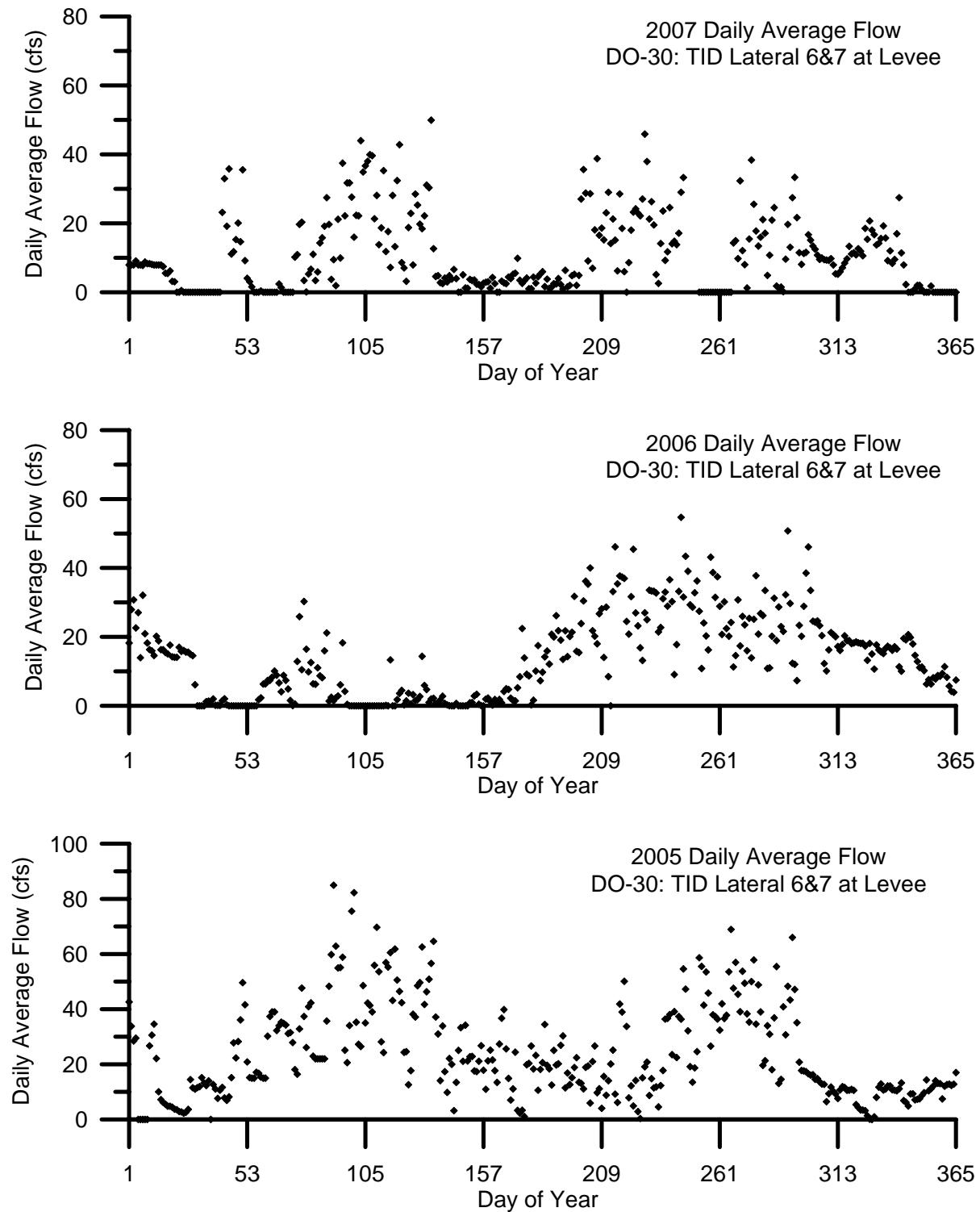


Figure 52: 2005 through 2007 flow plot for DO-30 TID Lateral 6 & 7 at Levee

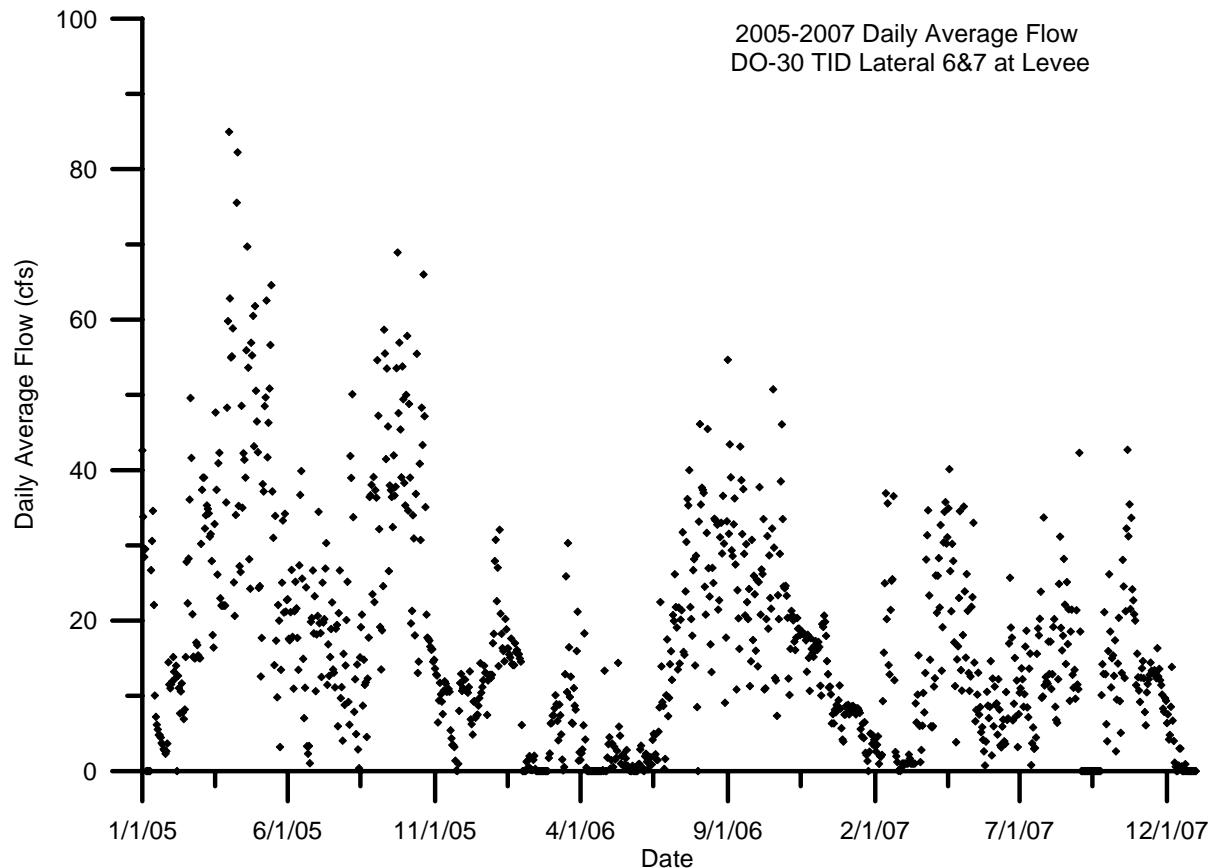


Figure 53: 2005 through 2007 flow plots for DO-31 New Jerusalem Drain

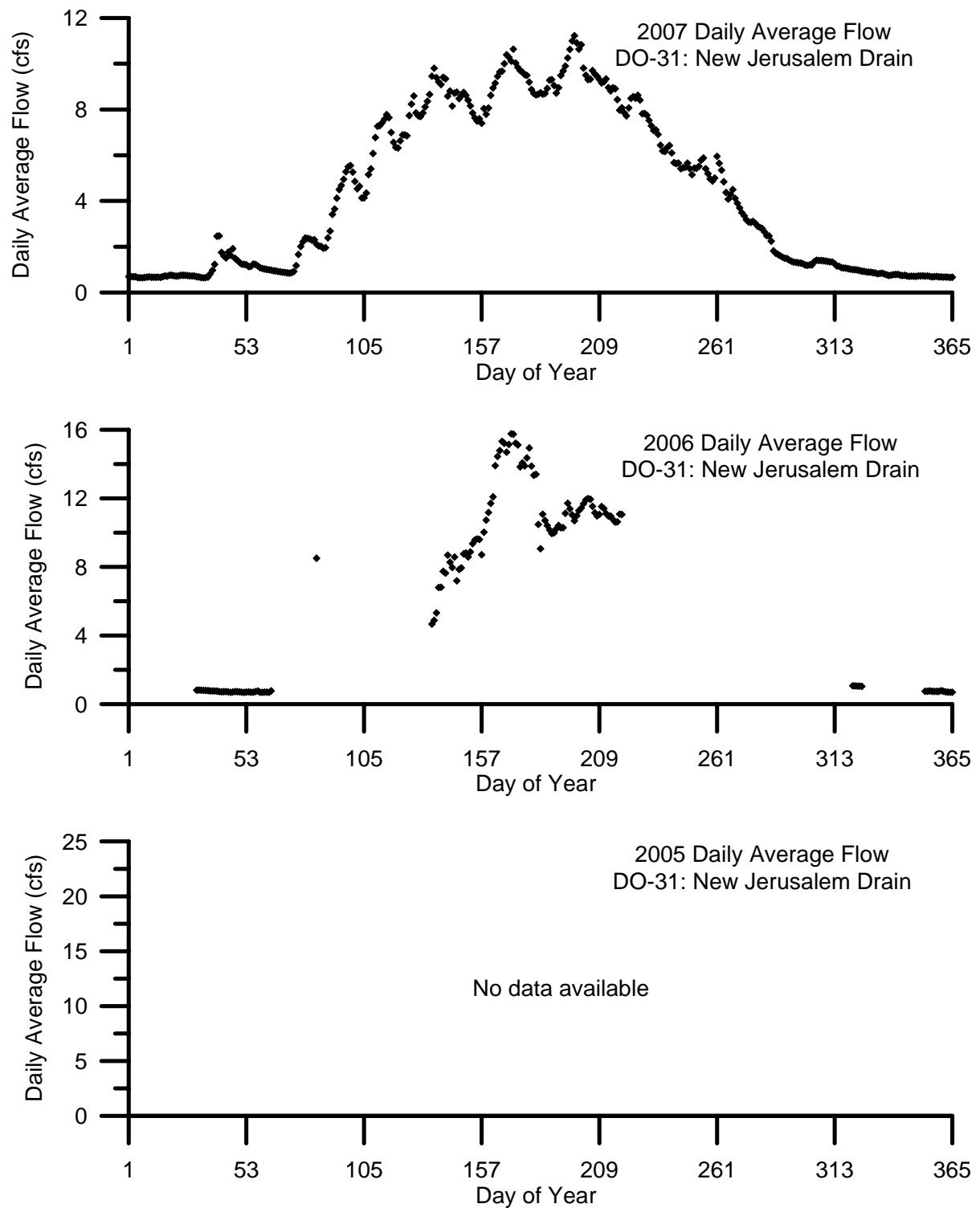


Figure 54: 2005 through 2007 flow plot for DO-31 New Jerusalem Drain

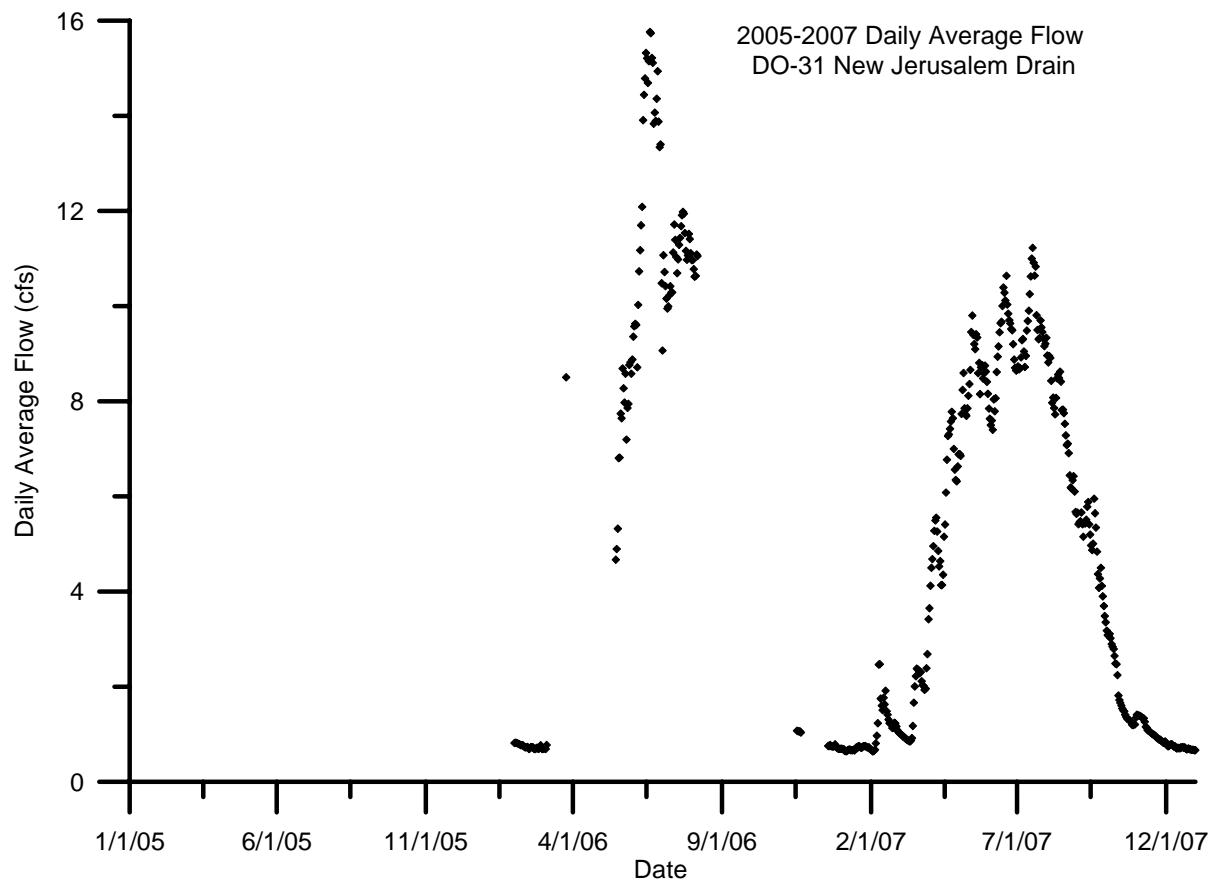


Figure 55: 2005 through 2007 flow plots for DO-33 Hospital Creek

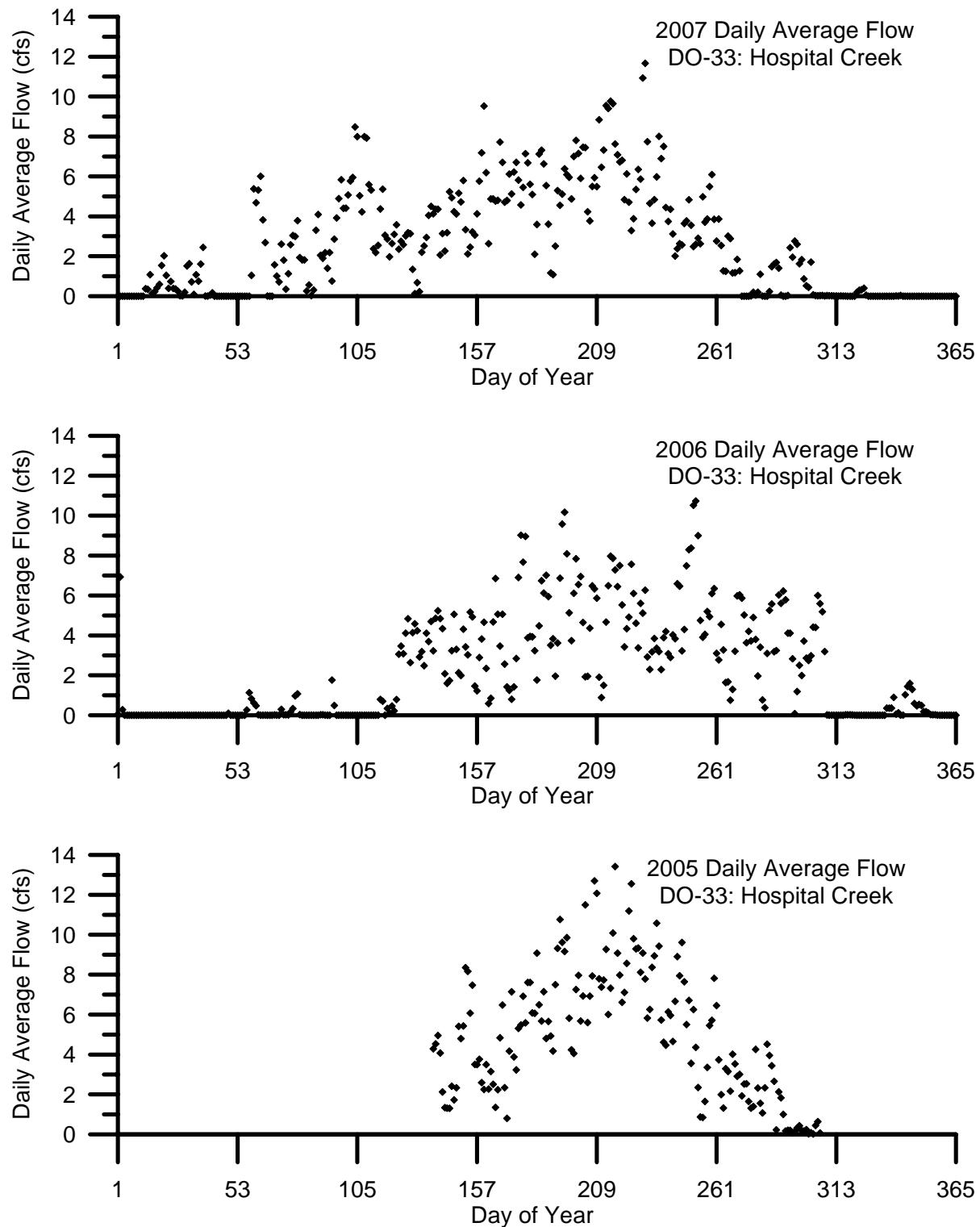


Figure 56: 2005 through 2007 flow plot for DO-33 Hospital Creek

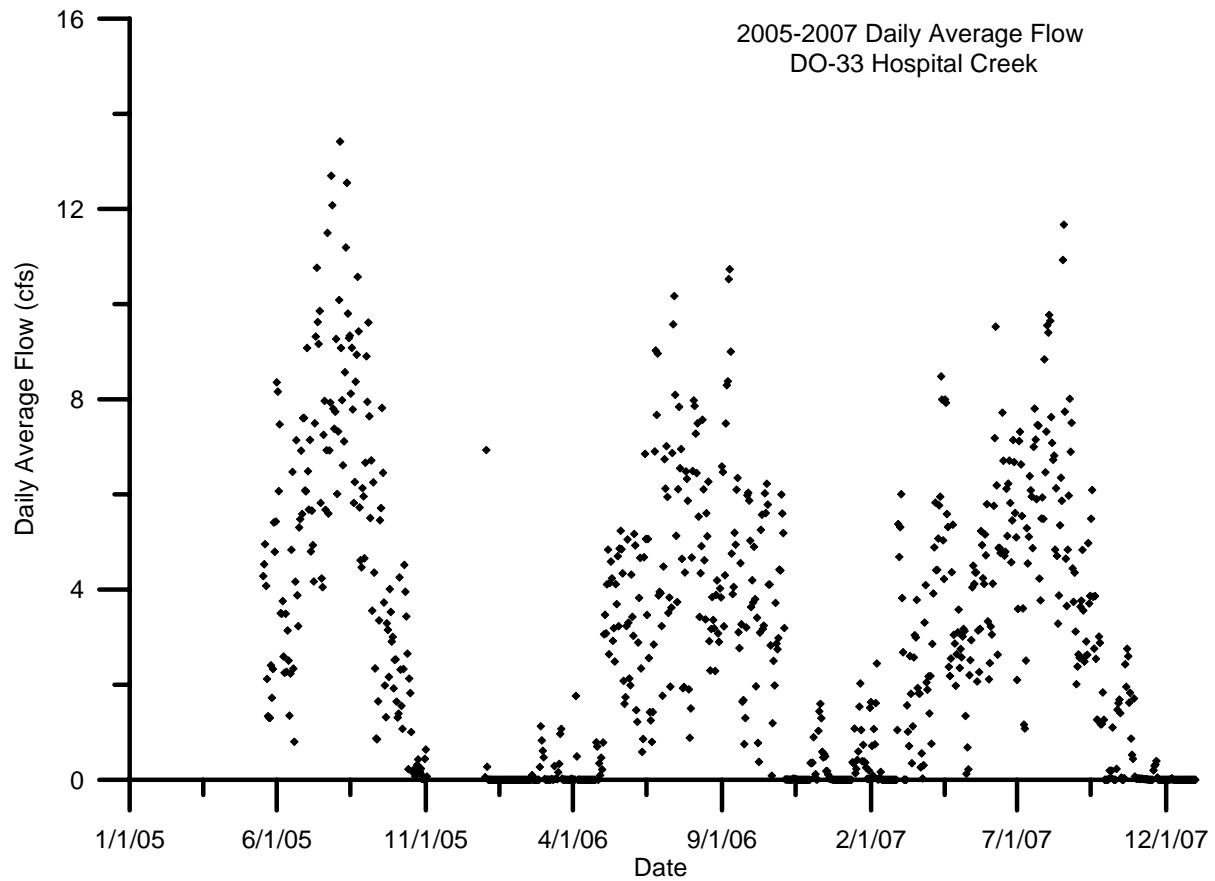


Figure 57: 2005 through 2007 flow plots for DO-34 Ingram Creek

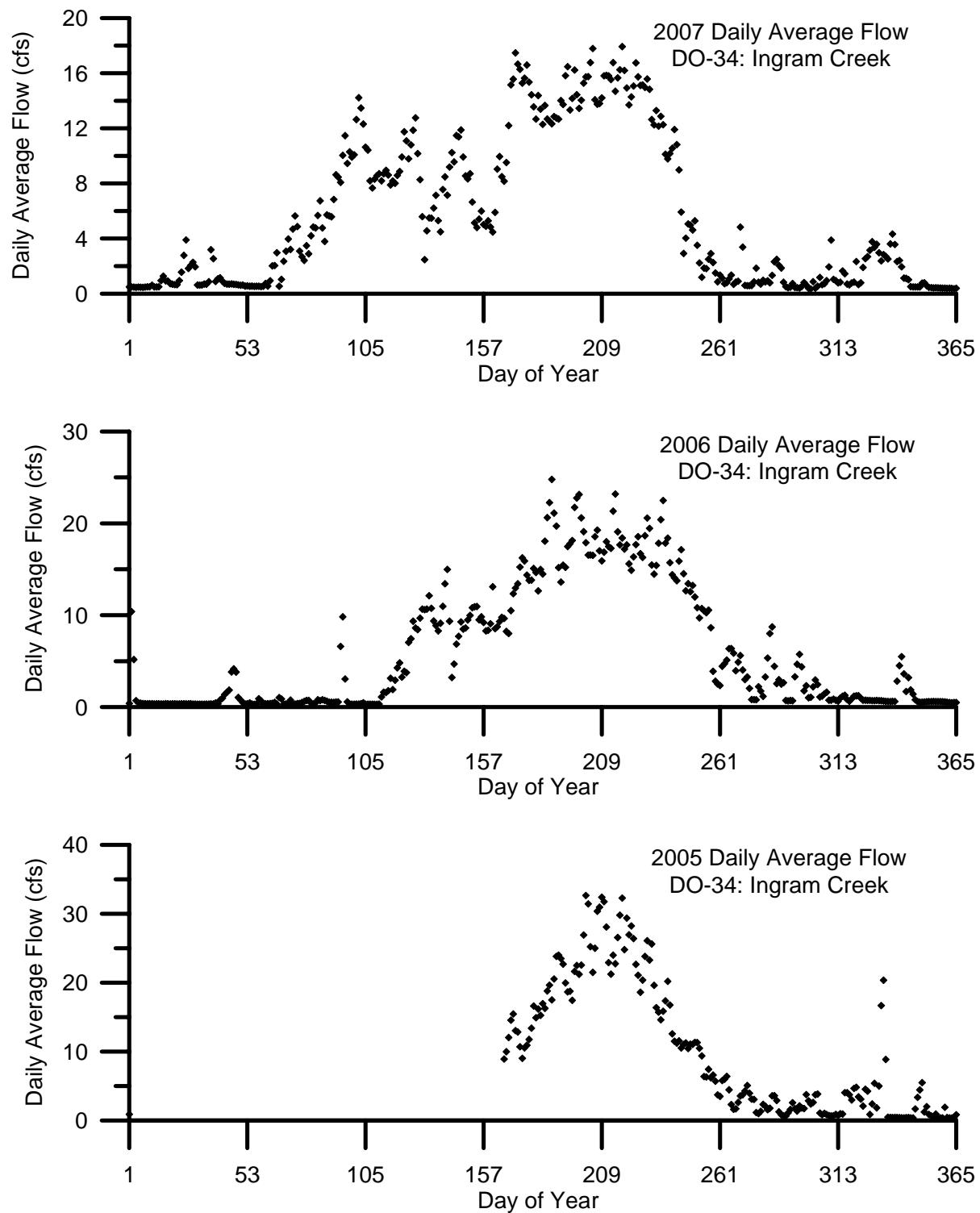


Figure 58: 2005 through 2007 flow plot for DO-34 Ingram Creek

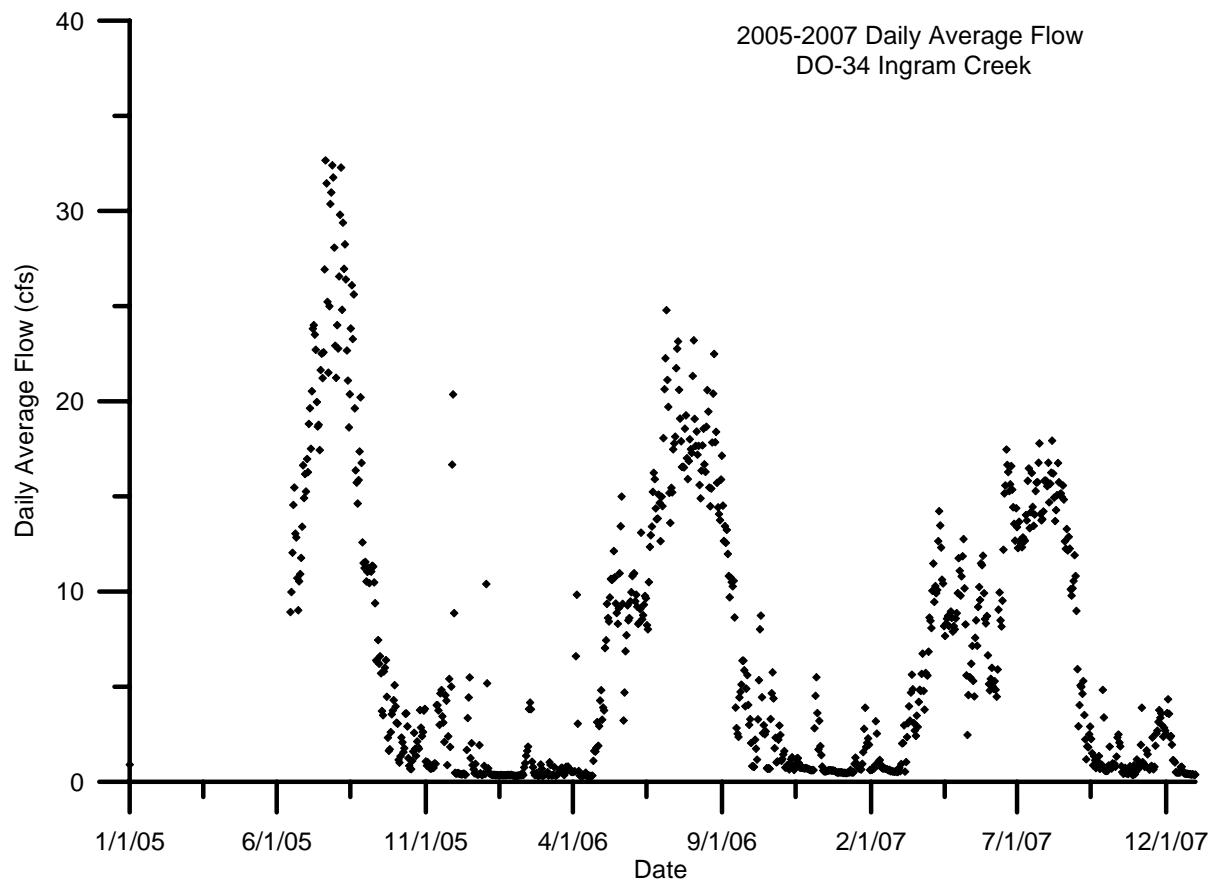


Figure 59: 2005 through 2007 flow plots for DO-35 Westley Wasteway

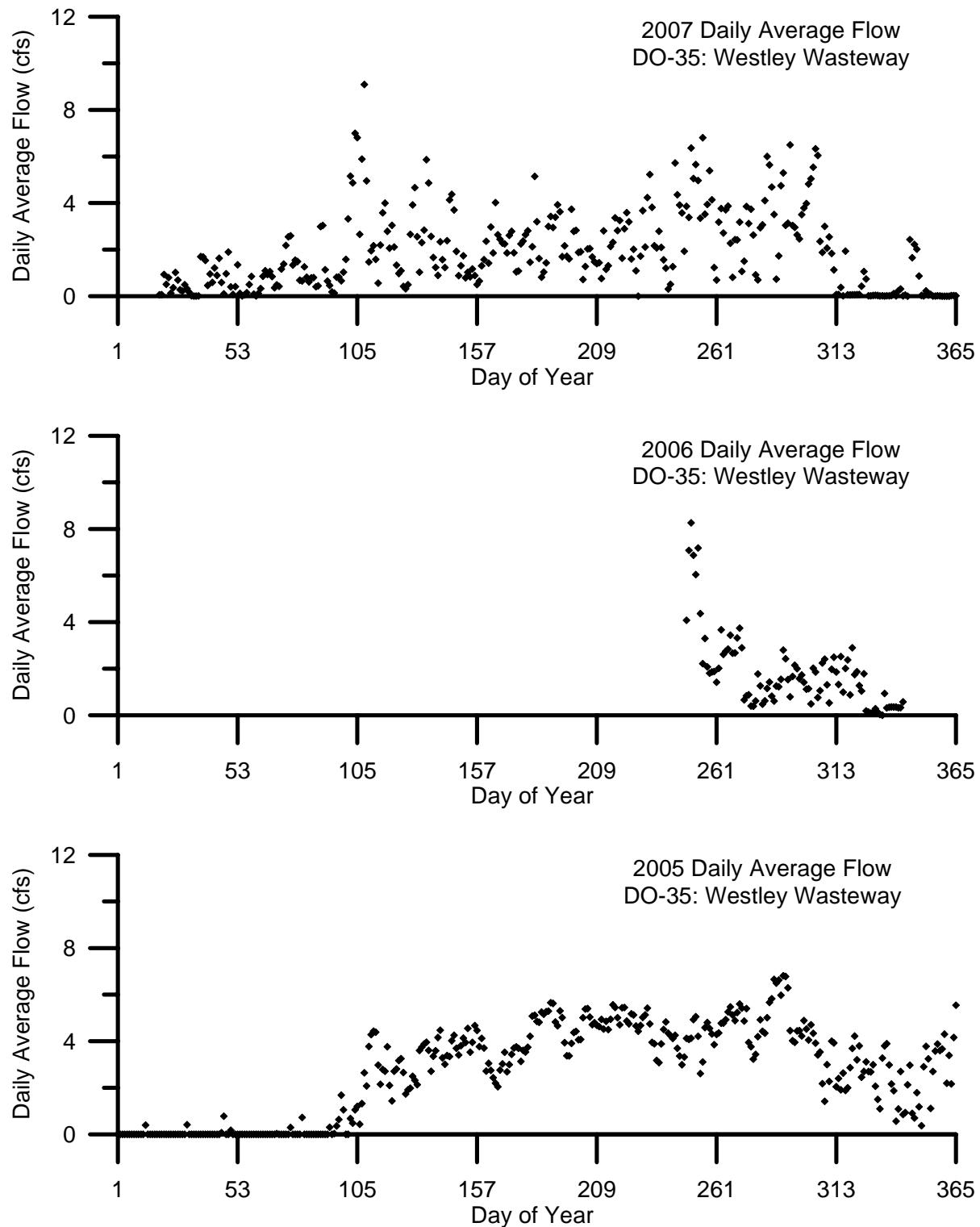


Figure 60: 2005 through 2007 flow plot for DO-35 Westley Wasteway

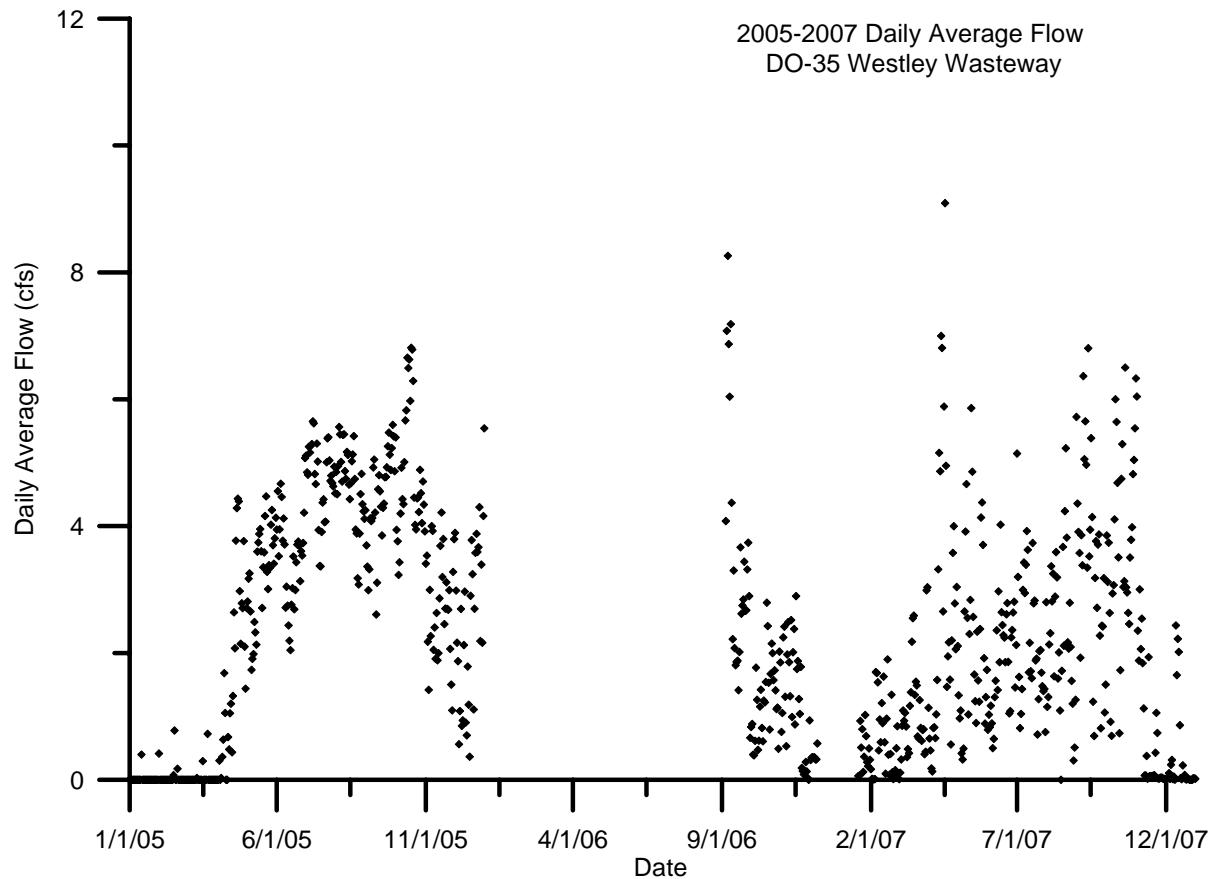


Figure 61: 2005 through 2007 flow plots for DO-36 Del Puerto Creek

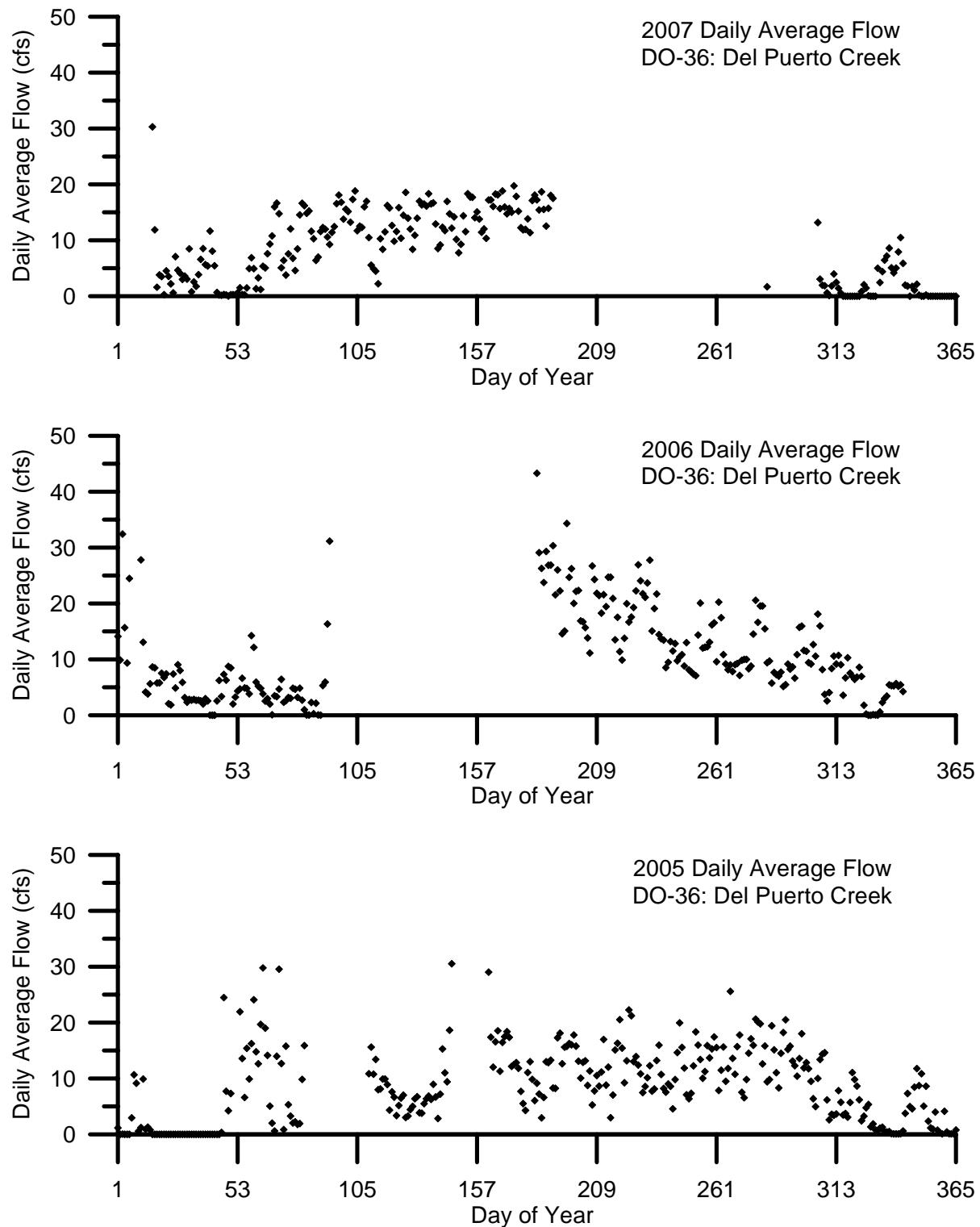


Figure 62: 2005 through 2007 flow plot for DO-36 Del Puerto Creek

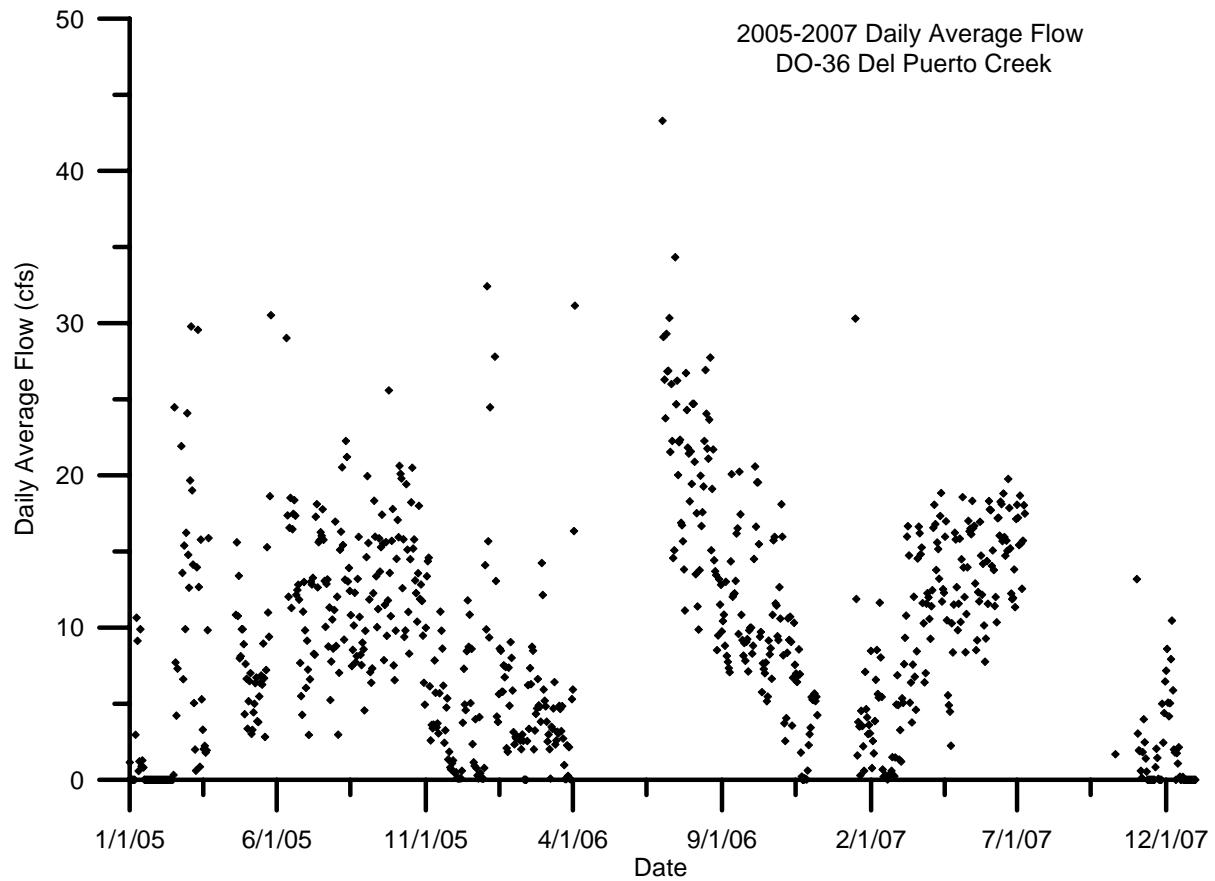


Figure 63: 2005 through 2007 flow plots for DO-38 Marshall Road Drain

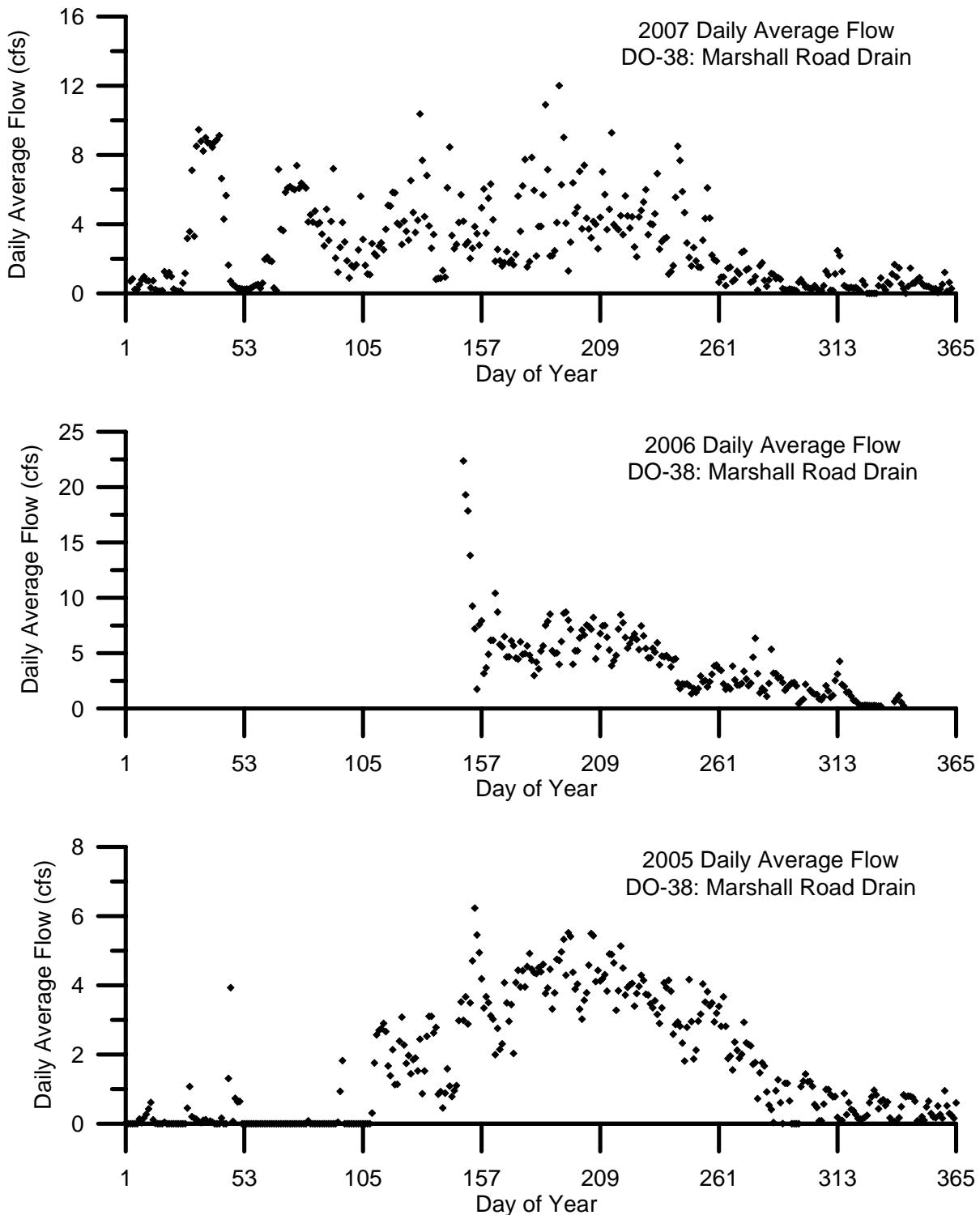


Figure 64: 2005 through 2007 flow plot for DO-38 Marshall Road Drain

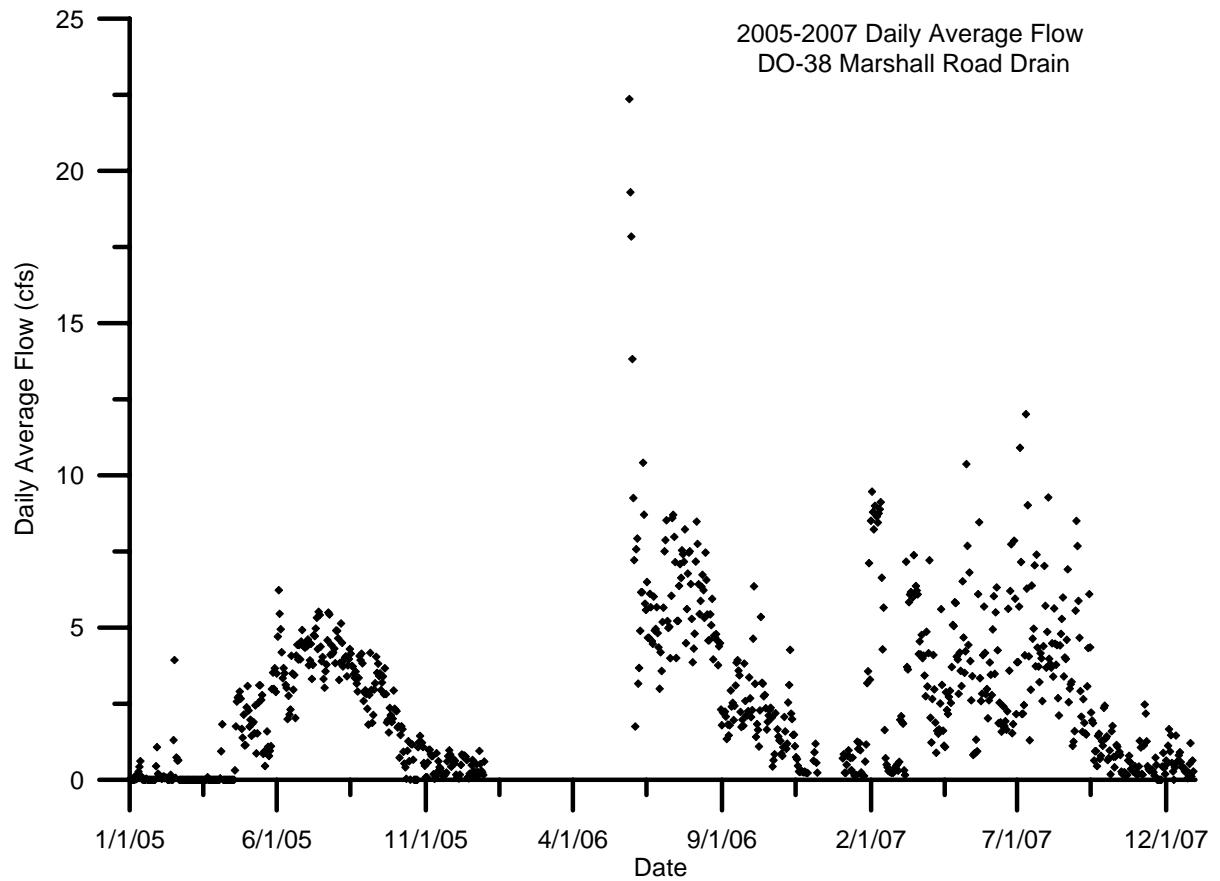


Figure 65: 2005 through 2007 flow plots for DO-40 Patterson Irrigation District

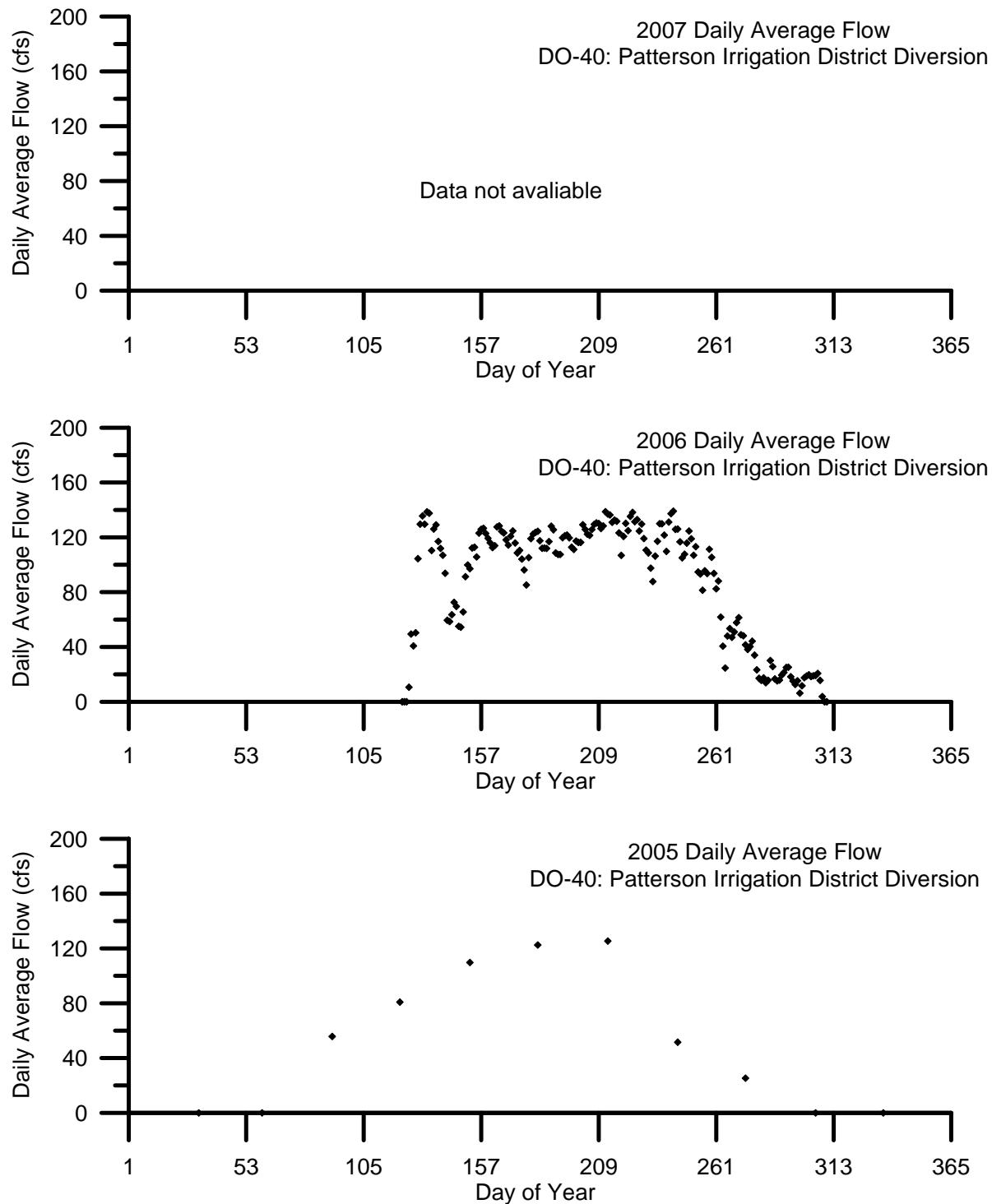


Figure 66: 2005 through 2007 flow plot for DO-40 Patterson Irrigation District

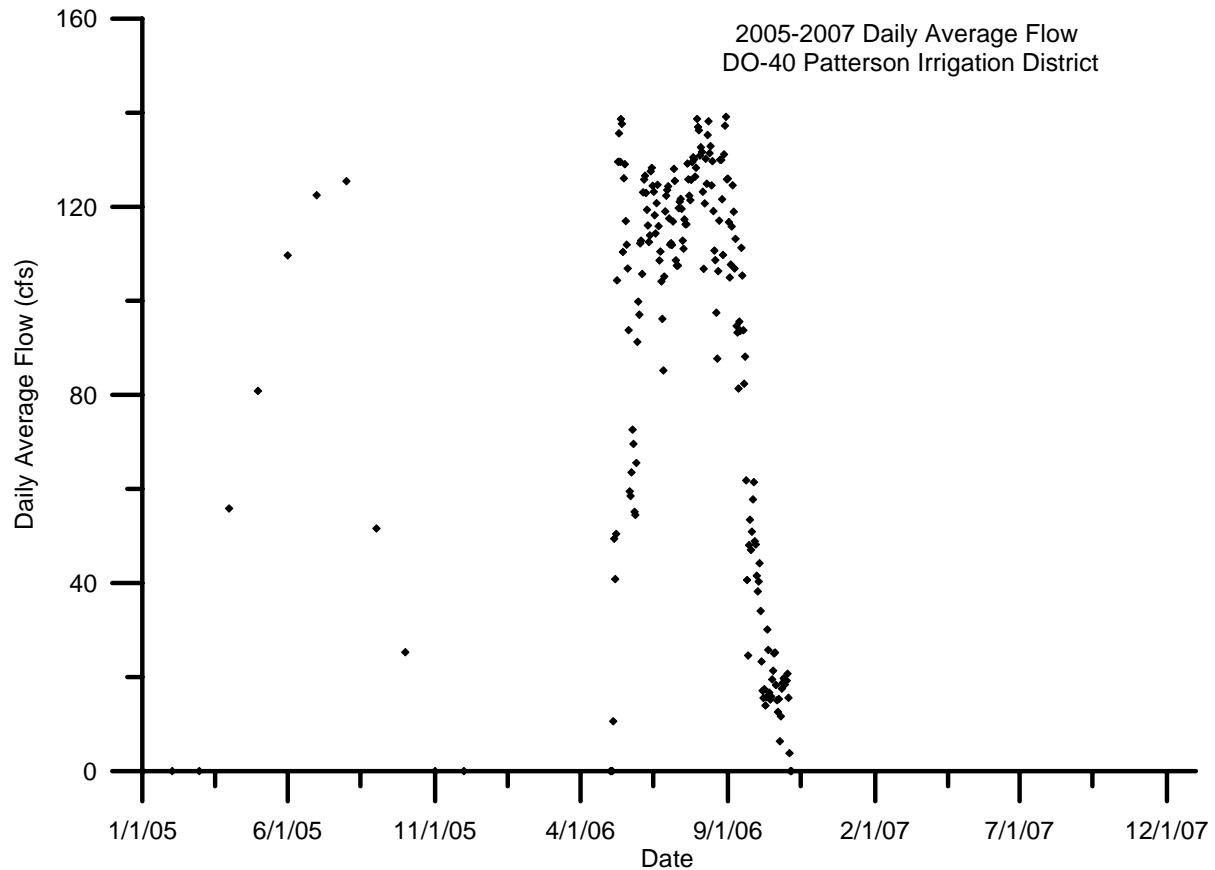


Figure 67: 2005 through 2007 flow plots for DO-41 West Stanislaus Irrigation District Diversion

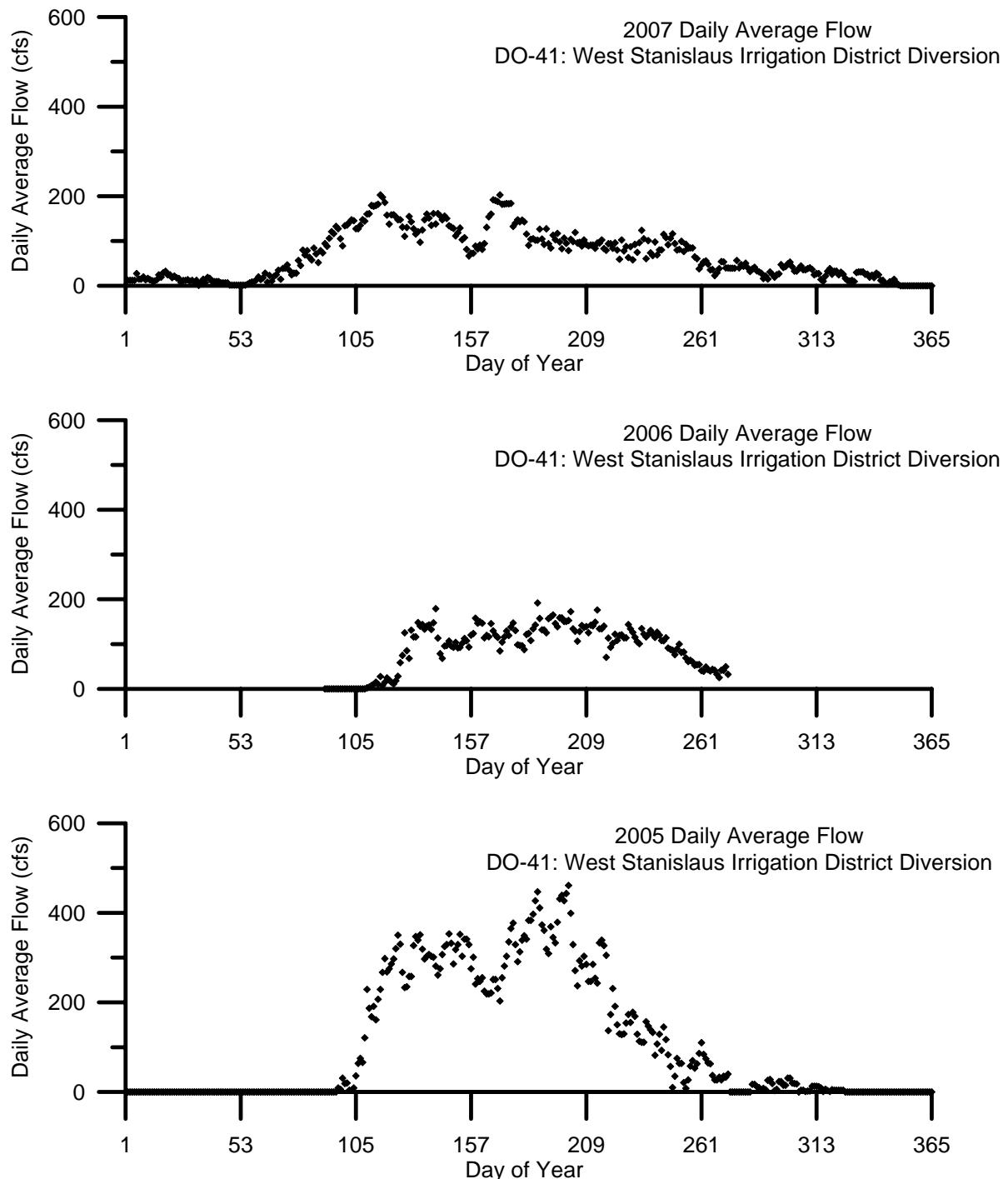


Figure 68: 2005 through 2007 flow plot for DO-41 West Stanislaus Irrigation District Diversion

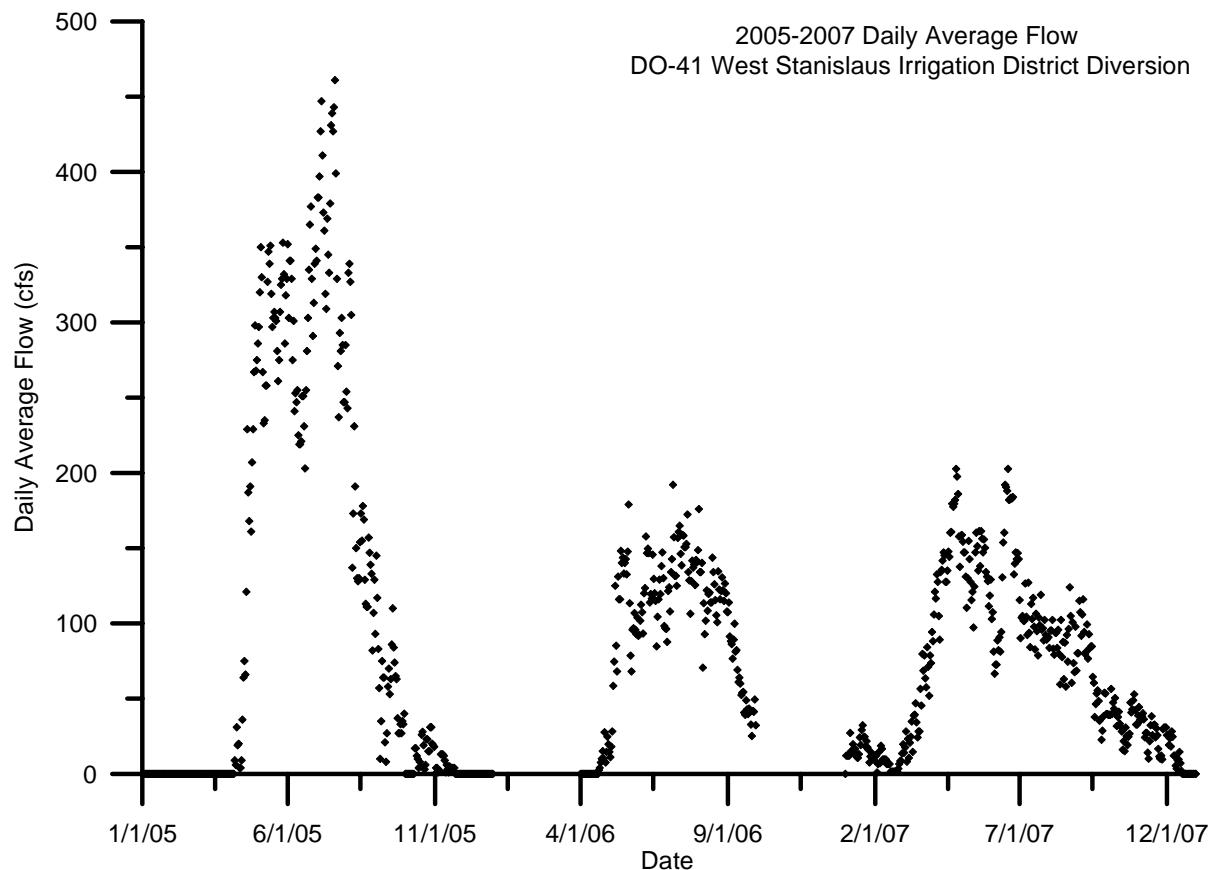


Figure 69: 2005 through 2007 flow plots for DO-42 Banta Carbona Irrigation District Diversion

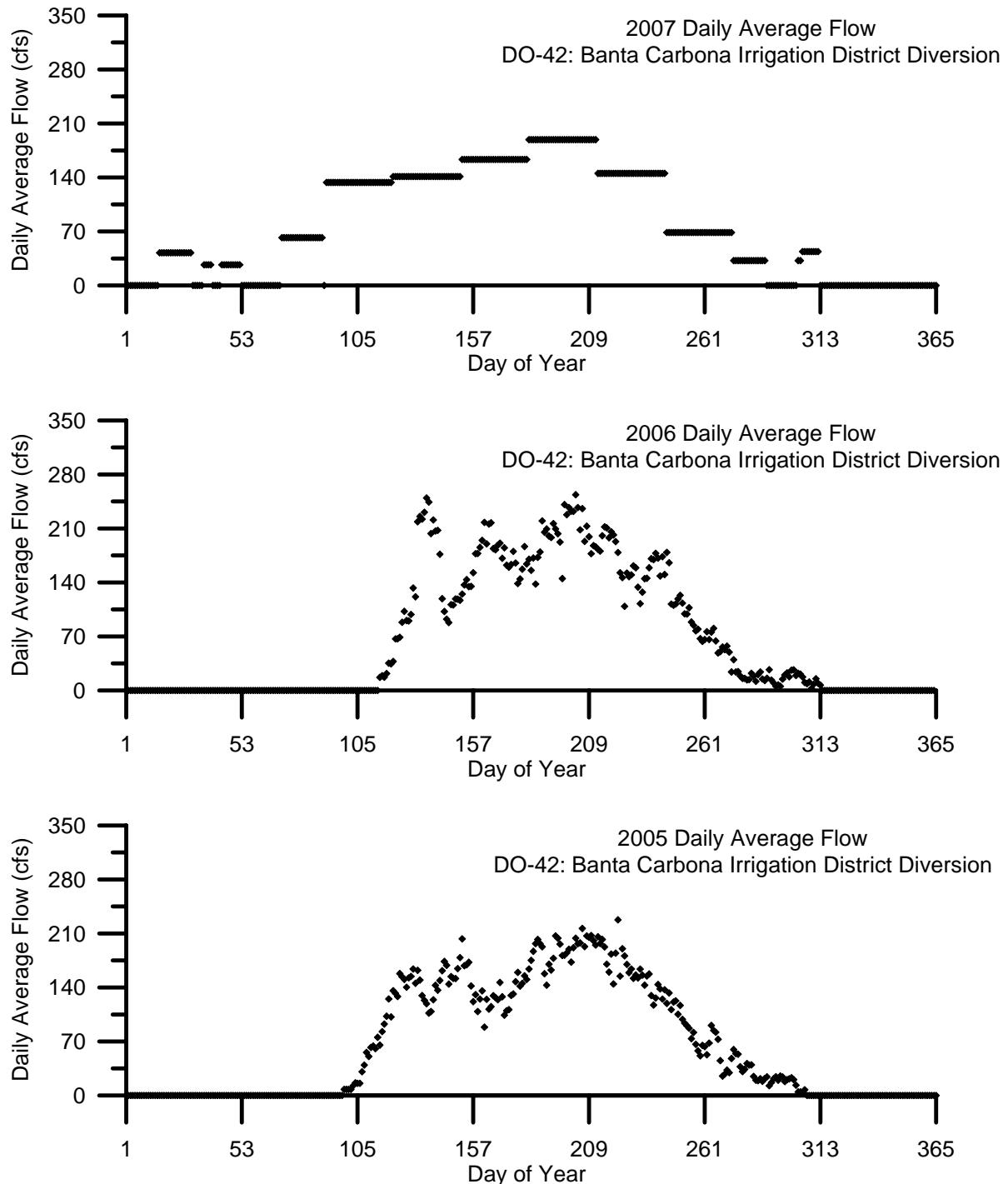


Figure 70: 2005 through 2007 flow plot for DO-42 Banta Carbona Irrigation District Diversion

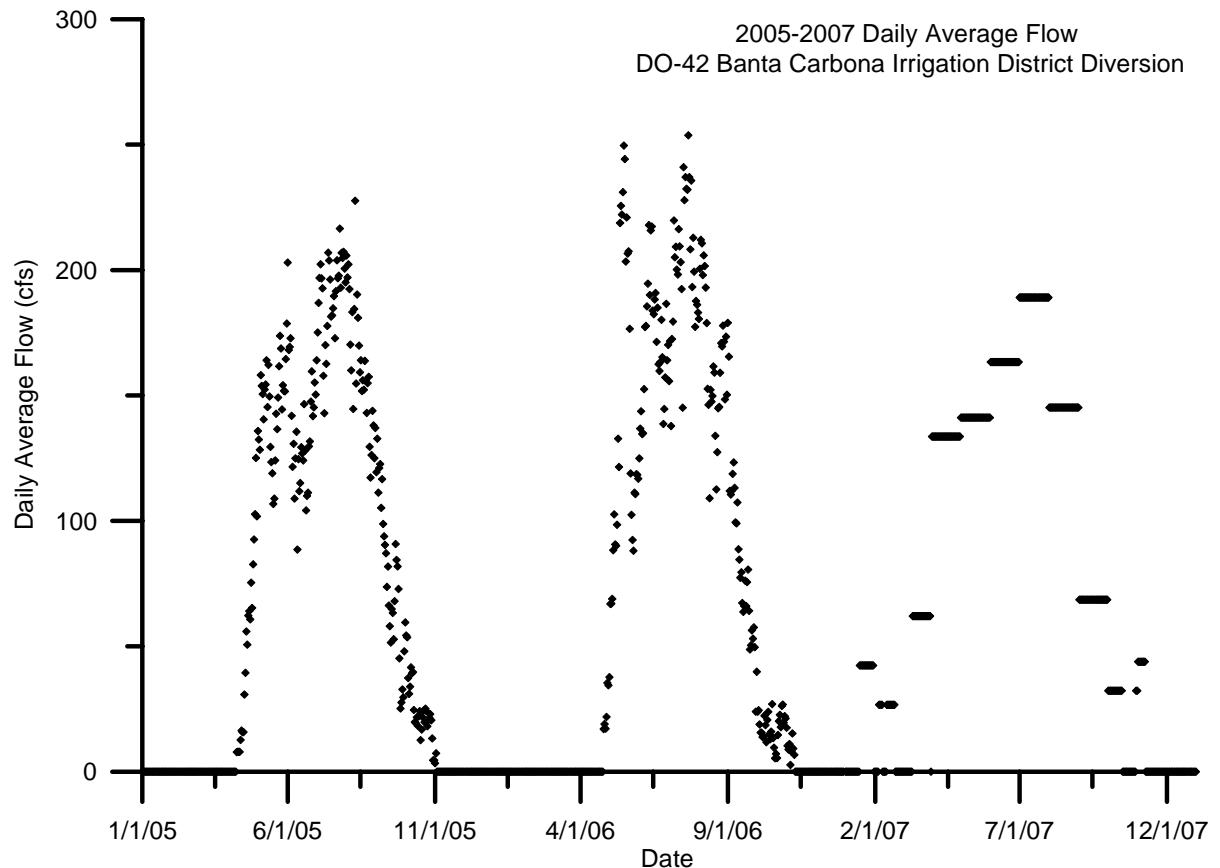


Figure 71: 2005 through 2007 flow plots for DO-43 El Solyo Water District Diversion

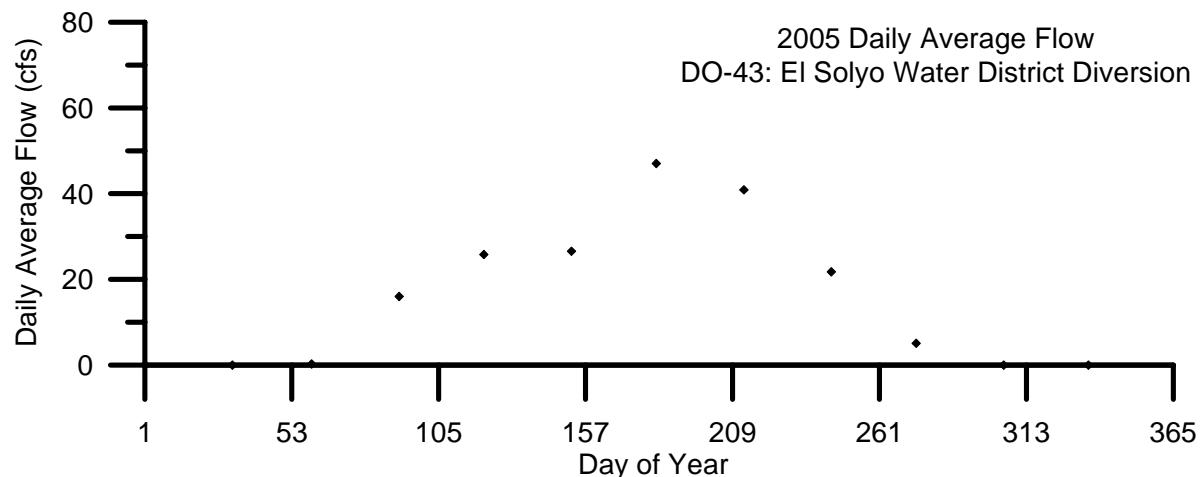
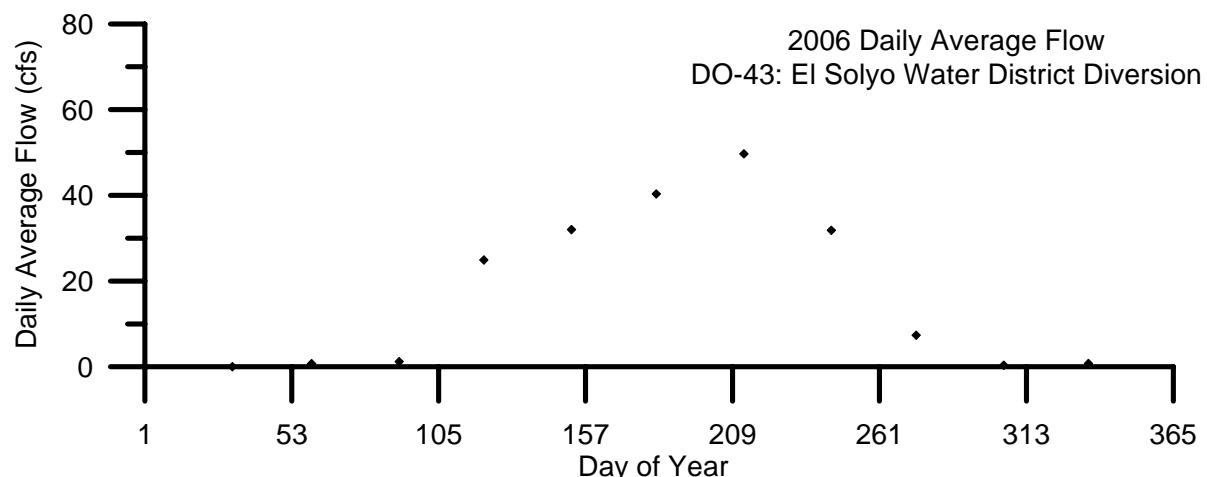
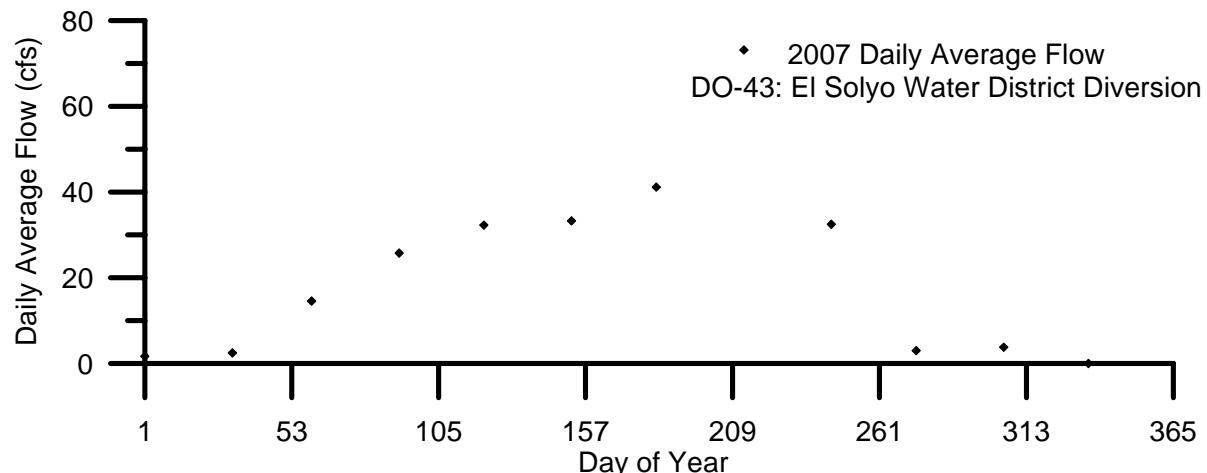


Figure 72: 2005 through 2007 flow plot for DO-43 El Solyo Water District Diversion

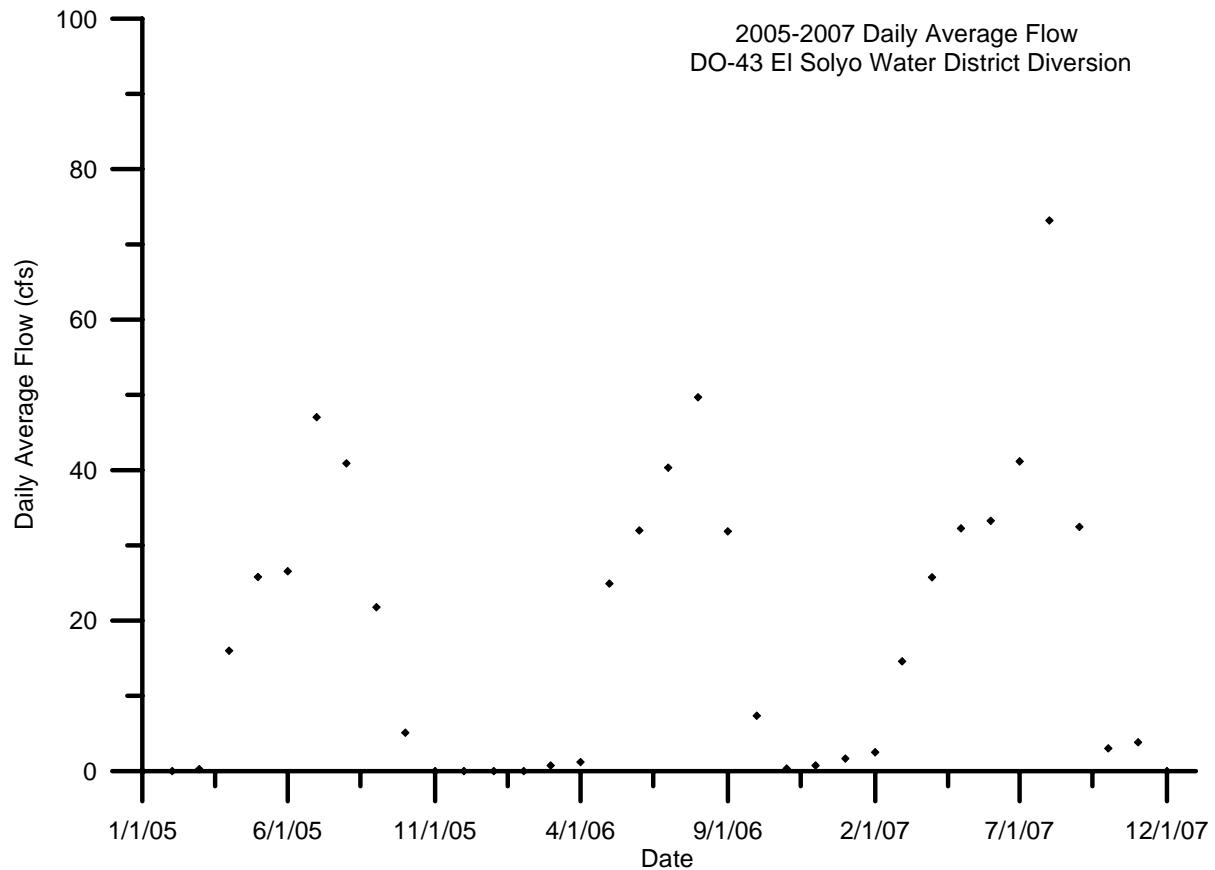


Figure 73: 2005 through 2007 flow plots for DO-44 San Luis Drain End

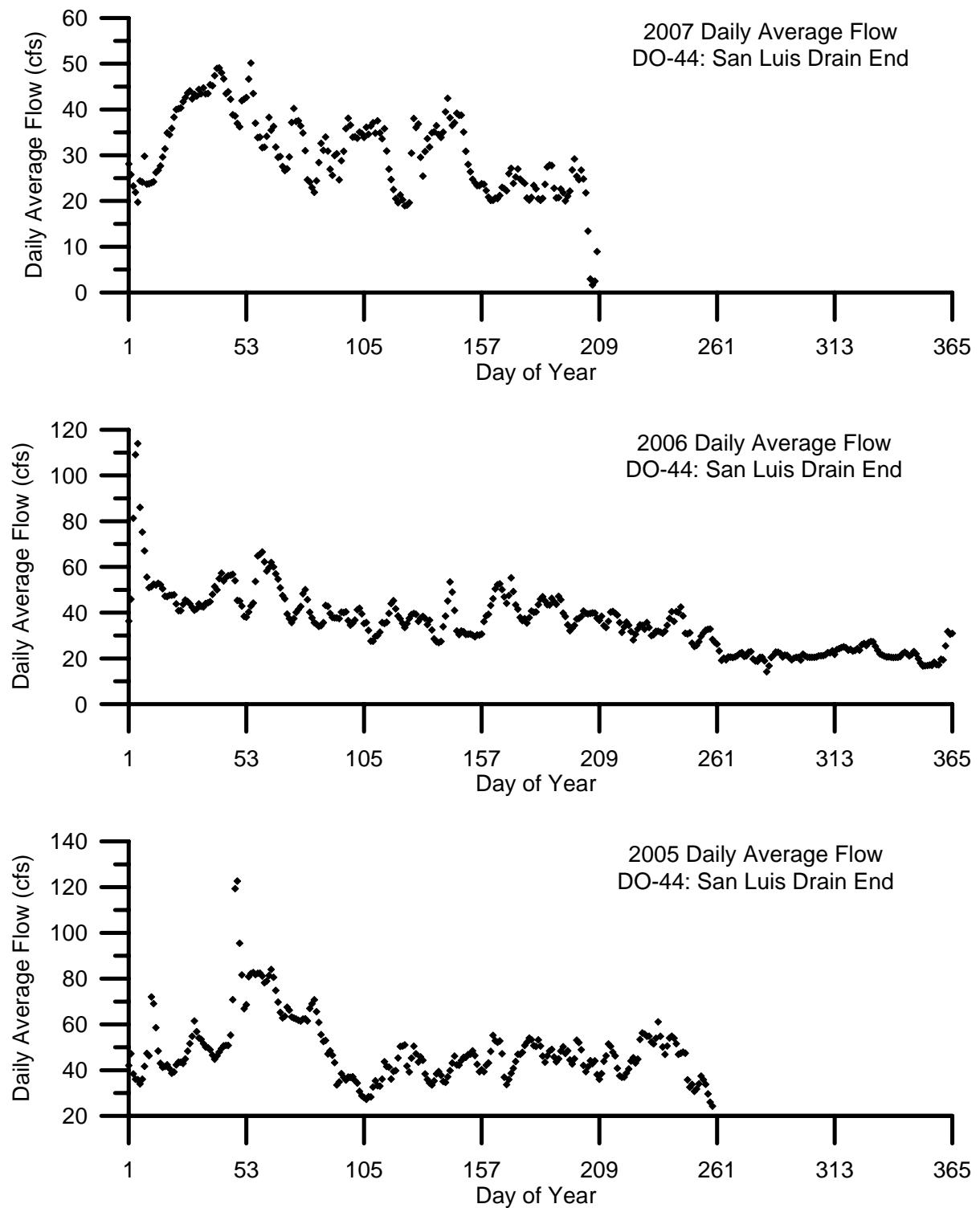


Figure 74: 2005 through 2007 flow plot for DO-44 San Luis Drain End

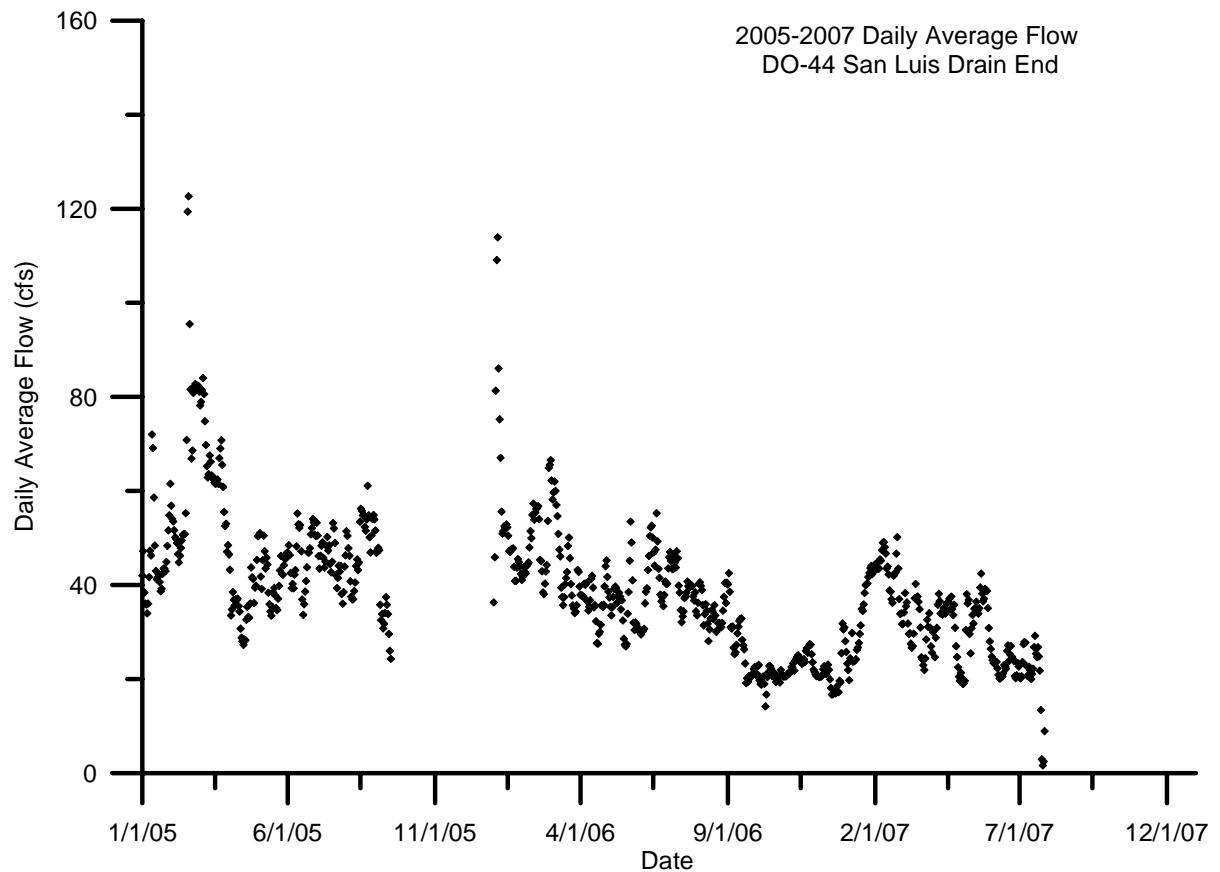


Figure 75: 2005 through 2007 flow plots for DO-45 Volta Wasteway

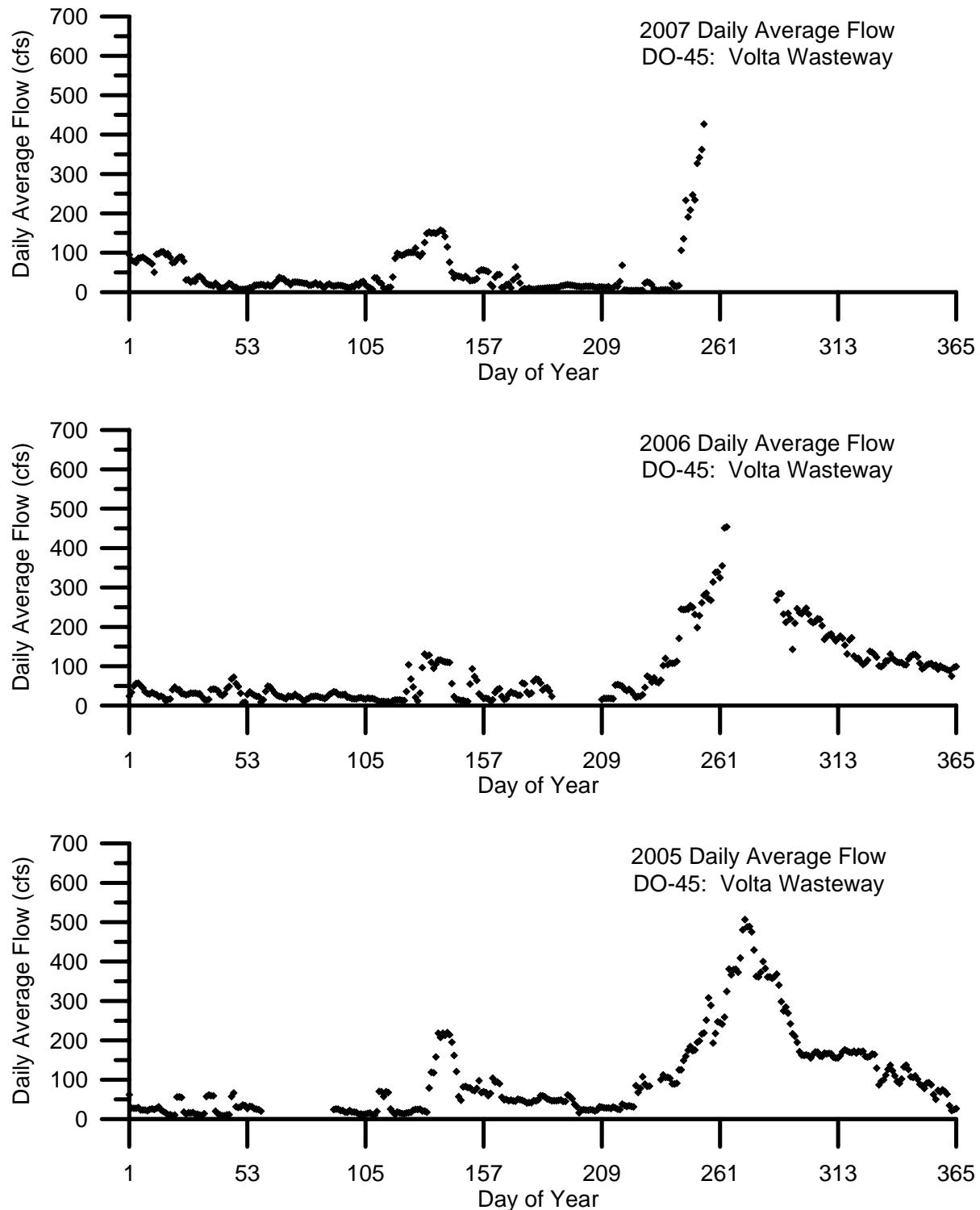


Figure 76: 2005 through 2007 flow plot for DO-45 Volta Wasteway

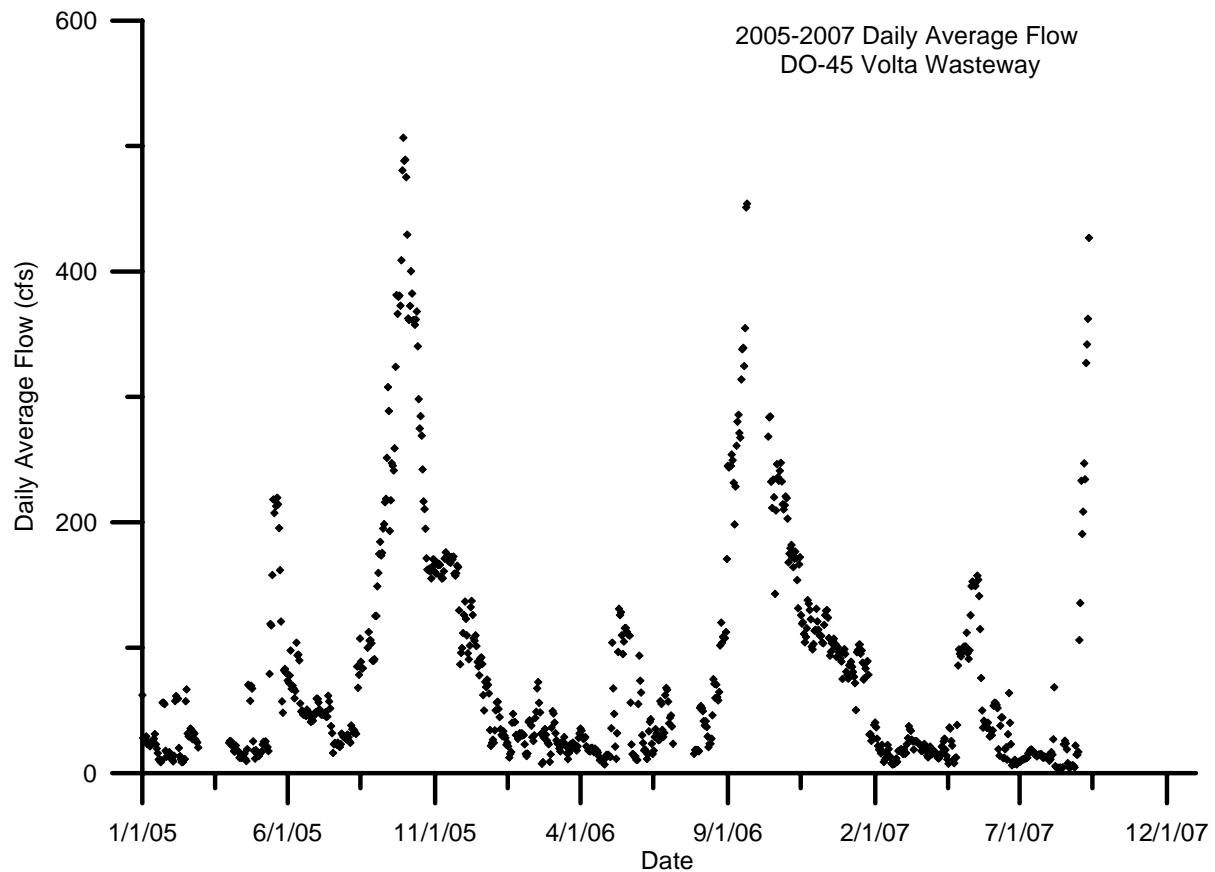


Figure 77: 2005 through 2007 flow plots for DO-46 Mud Slough at Gun Club Road

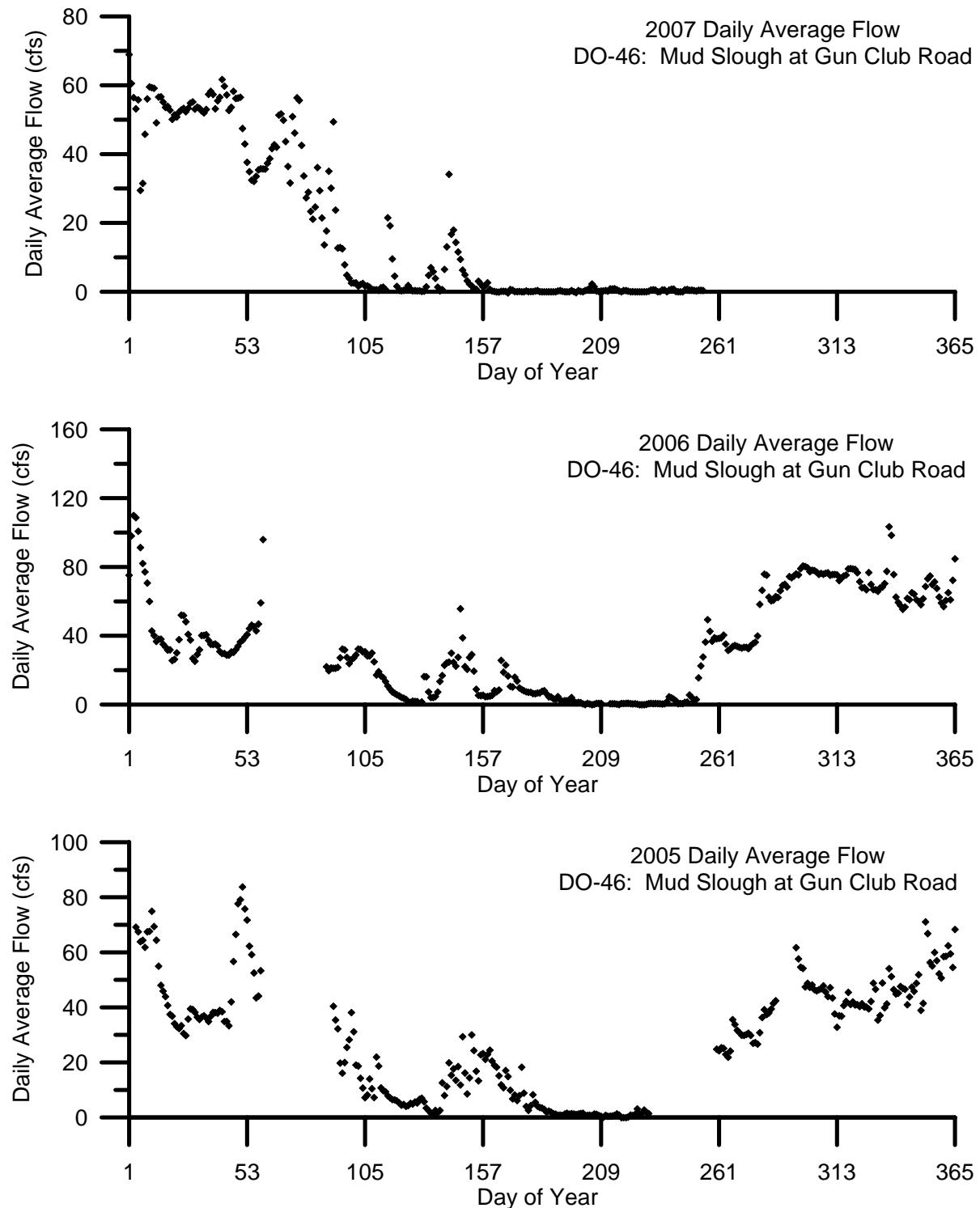


Figure 78: 2005 through 2007 flow plot for DO-46 Mud Slough at Gun Club Road

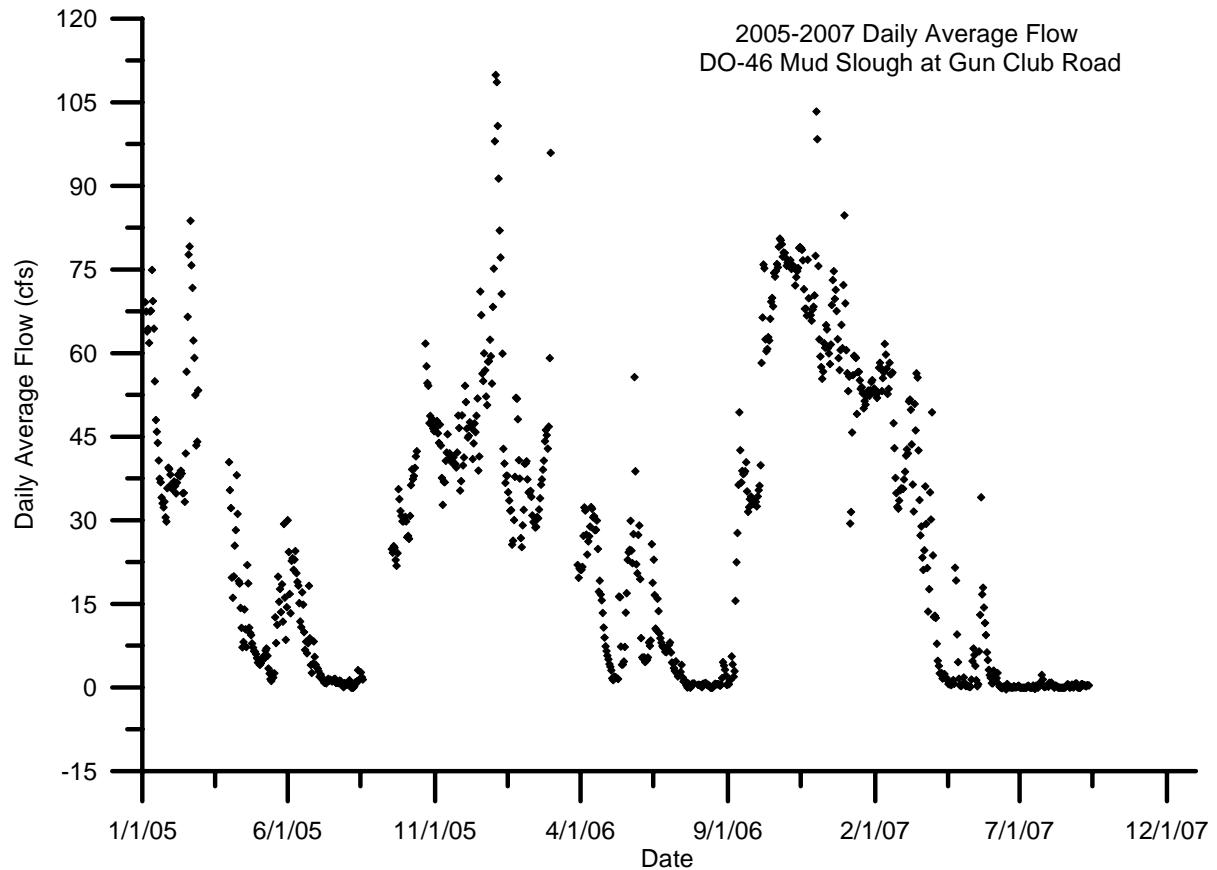


Figure 79: 2005 through 2007 flow plots for DO-47 Delta-Mendota Canal at HW 140

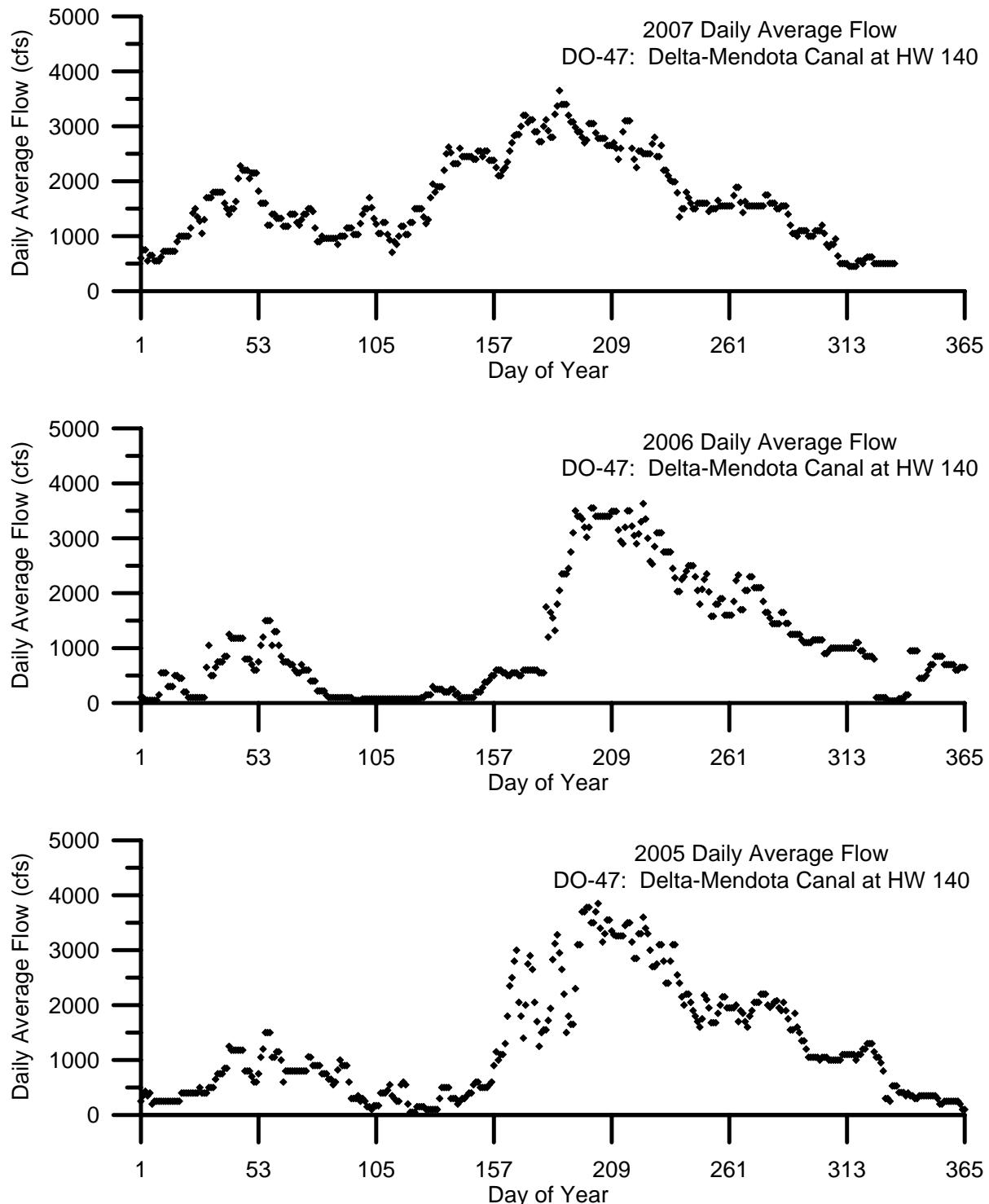


Figure 80: 2005 through 2007 flow plot for DO-47 Delta-Mendota Canal at HW 140

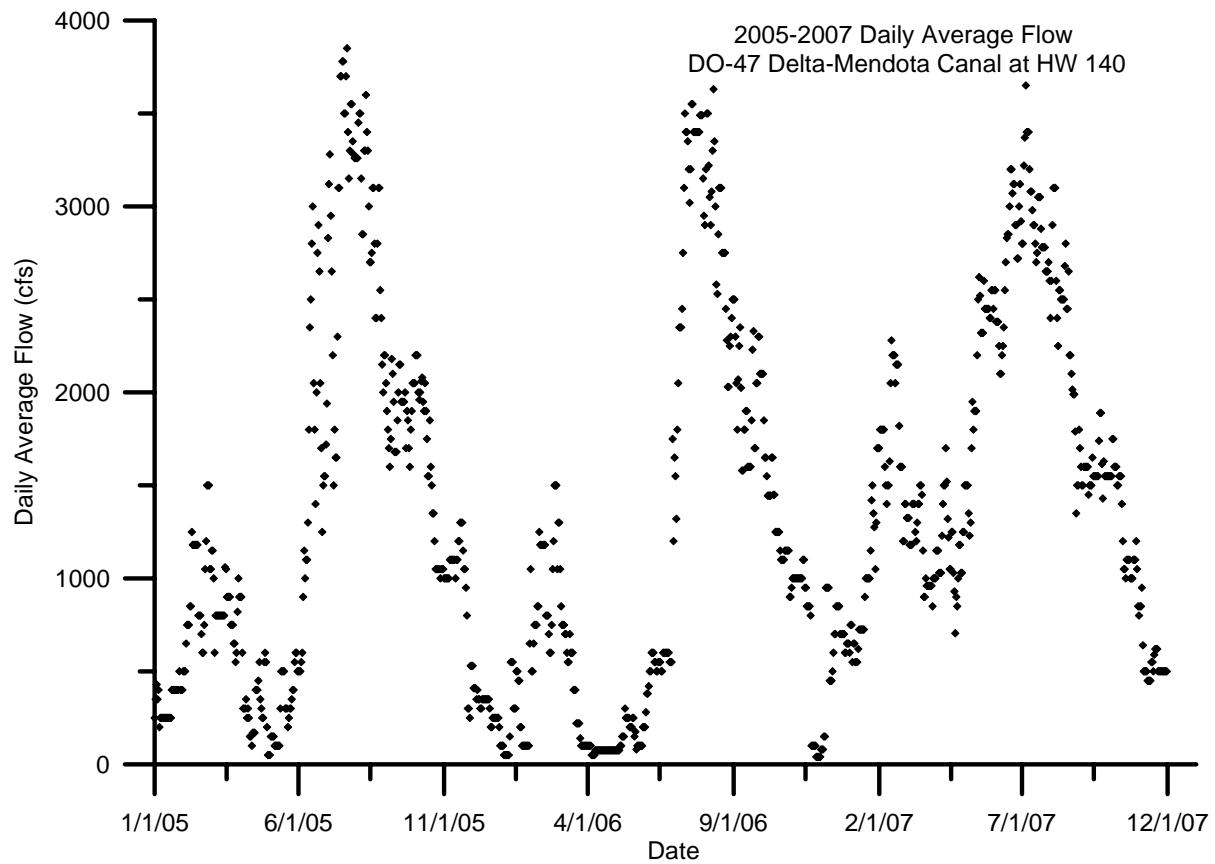


Figure 81: 2005 through 2007 flow plots for DO-48 San Luis Drain Site A (Check 17)

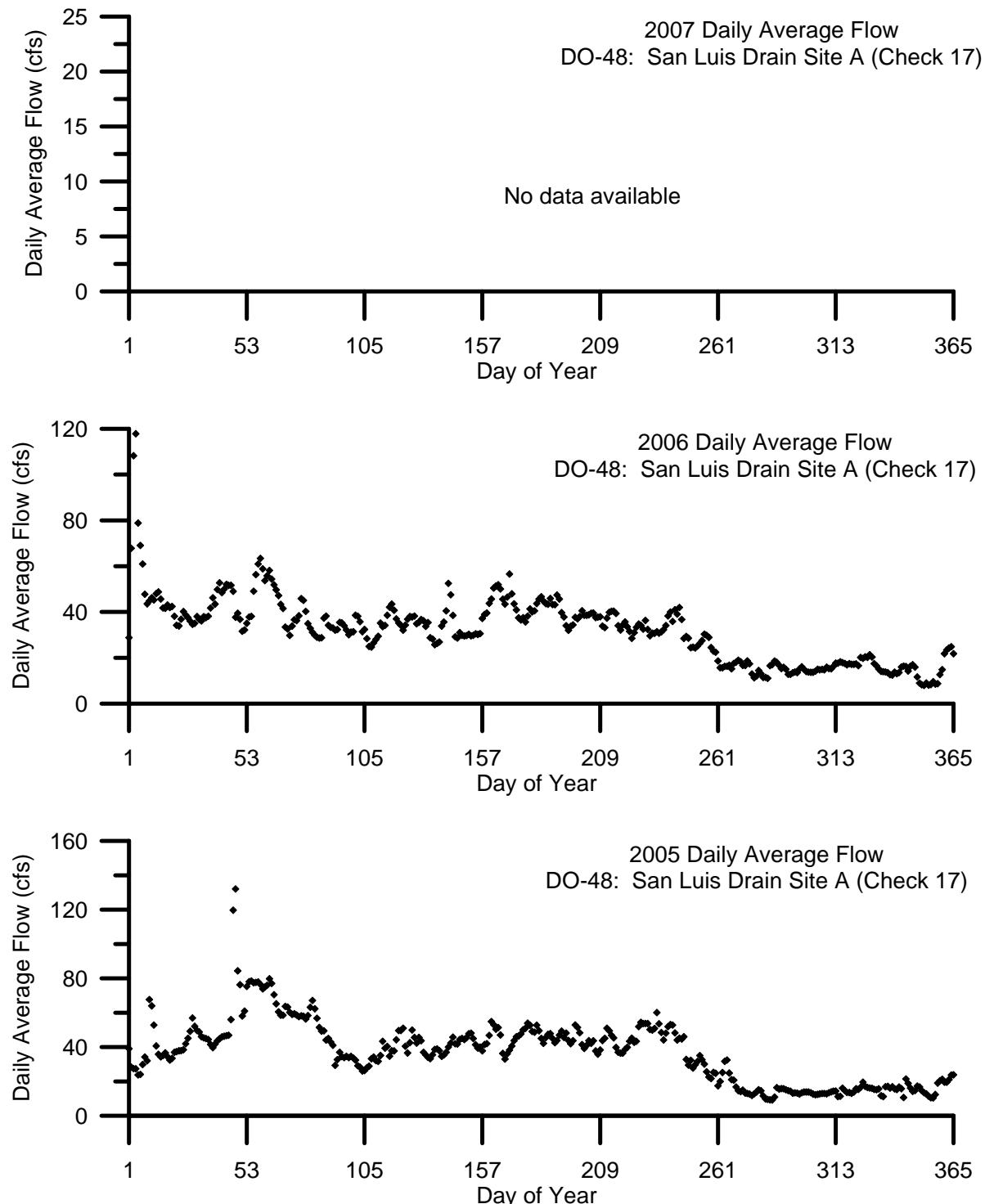


Figure 82: 2005 through 2007 flow plot for DO-48 San Luis Drain Site A (Check 17)

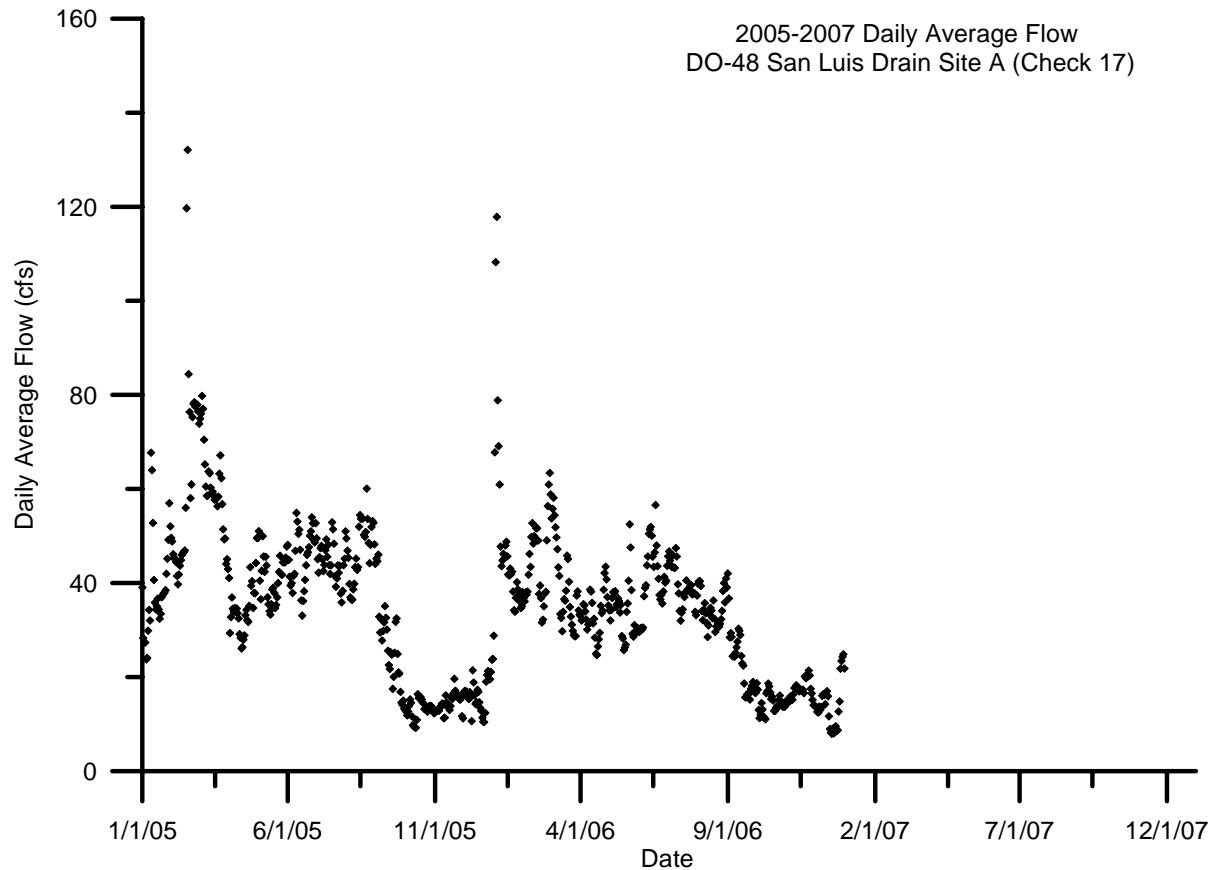


Figure 83: 2005 through 2007 flow plots for DO-49 PE-14 Grasslands Area Farmers

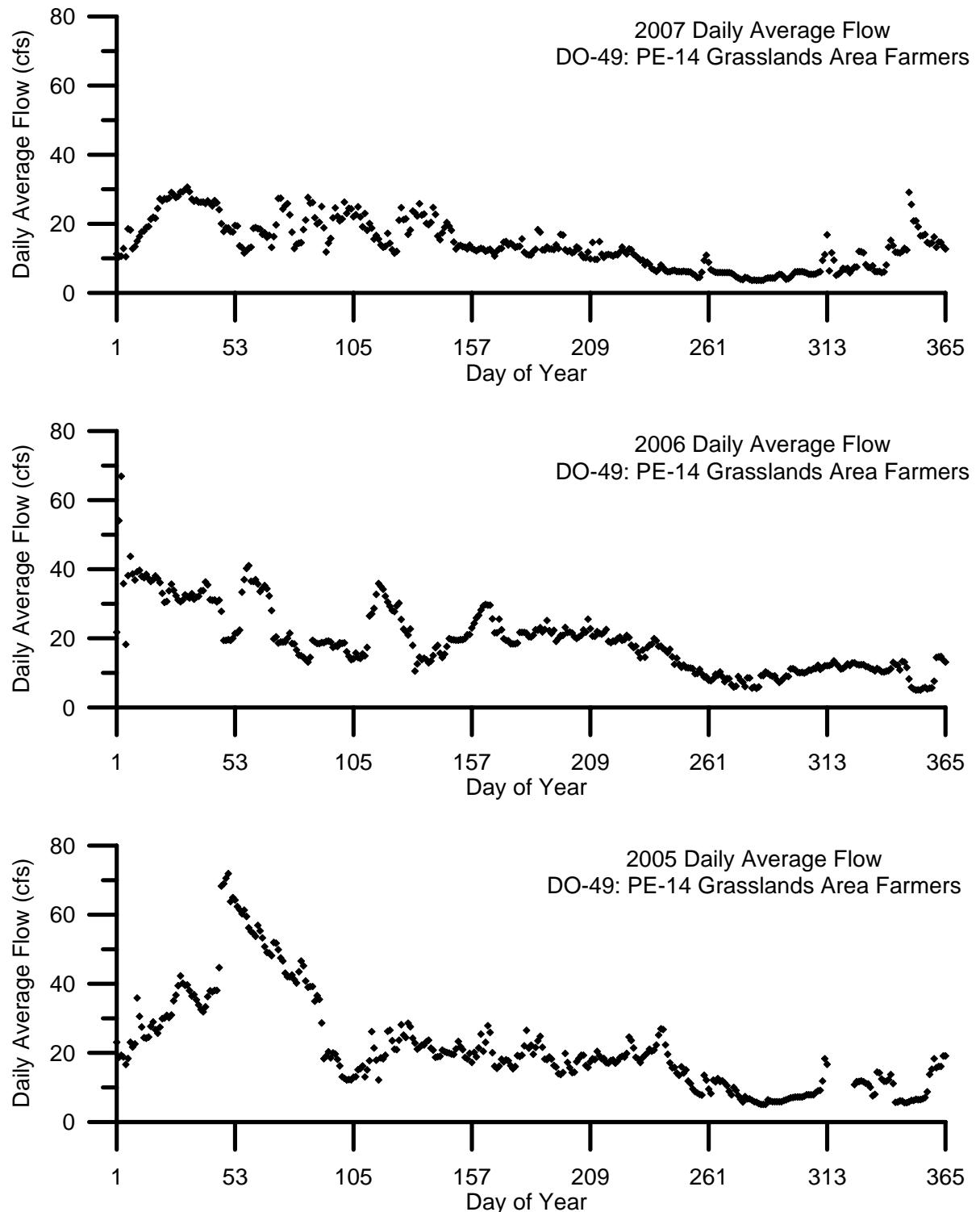


Figure 84: 2005 through 2007 flow plot for DO-49 PE-14 Grasslands Area Farmers

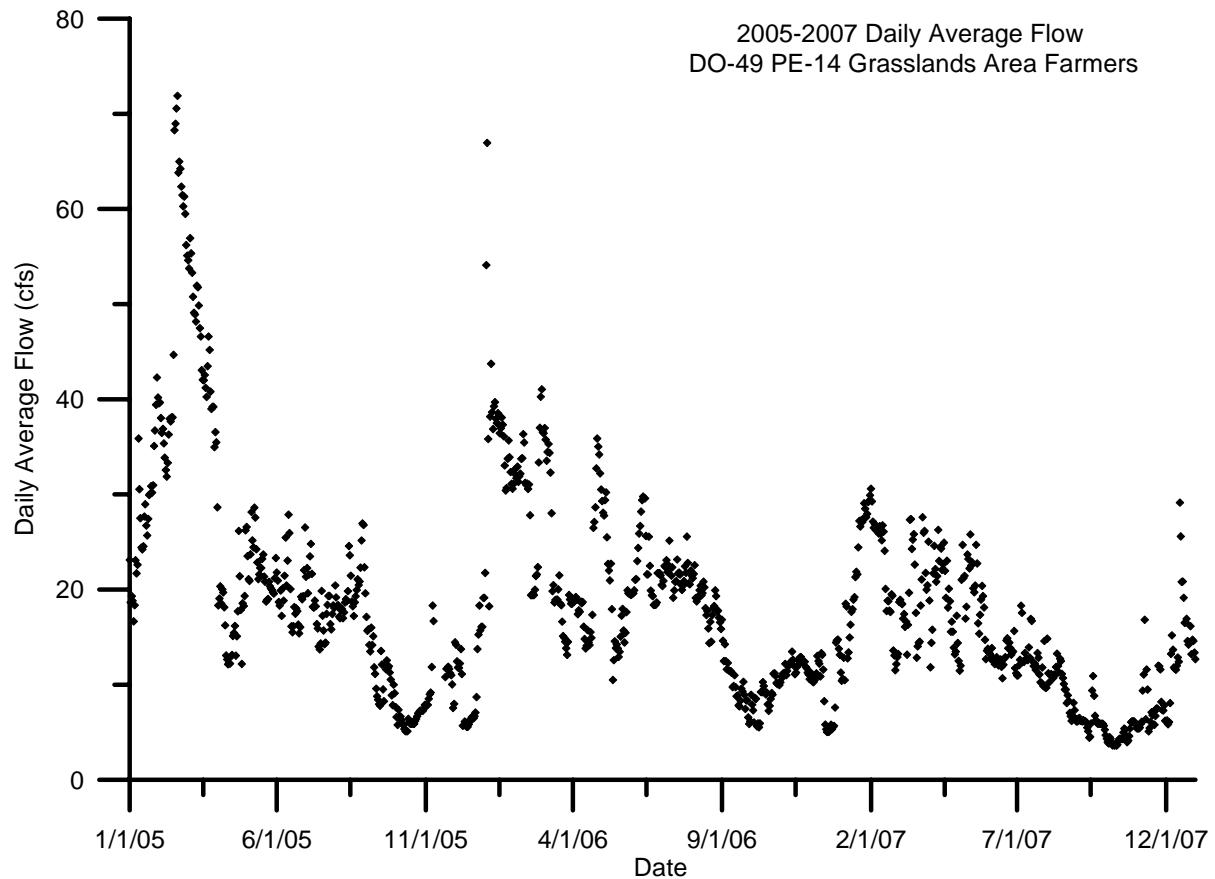


Figure 85: 2005 through 2007 flow plots for DO-50 FC-5 Grasslands Area Farmers

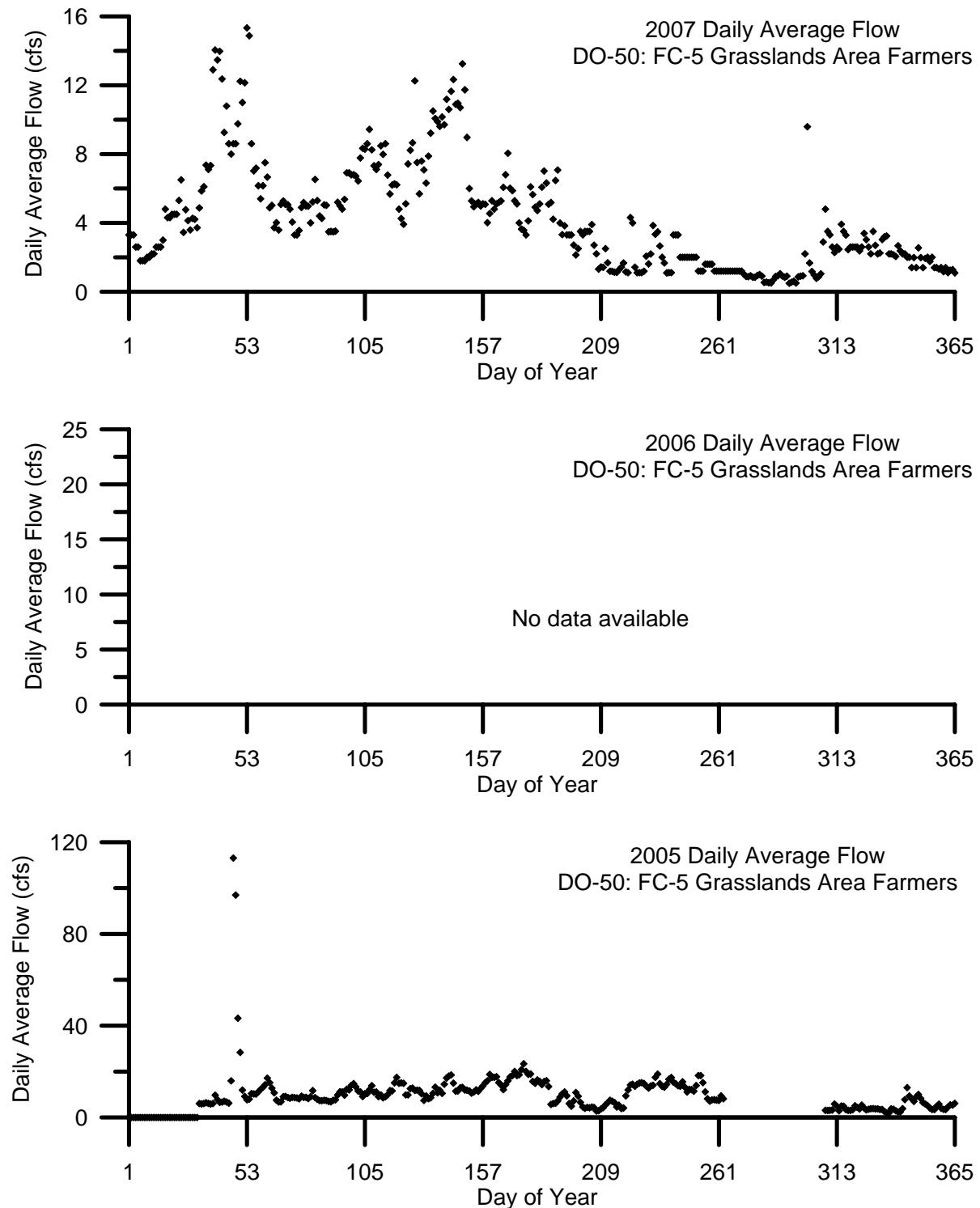


Figure 86: 2005 through 2007 flow plot for DO-50 FC-5 Grasslands Area Farmers

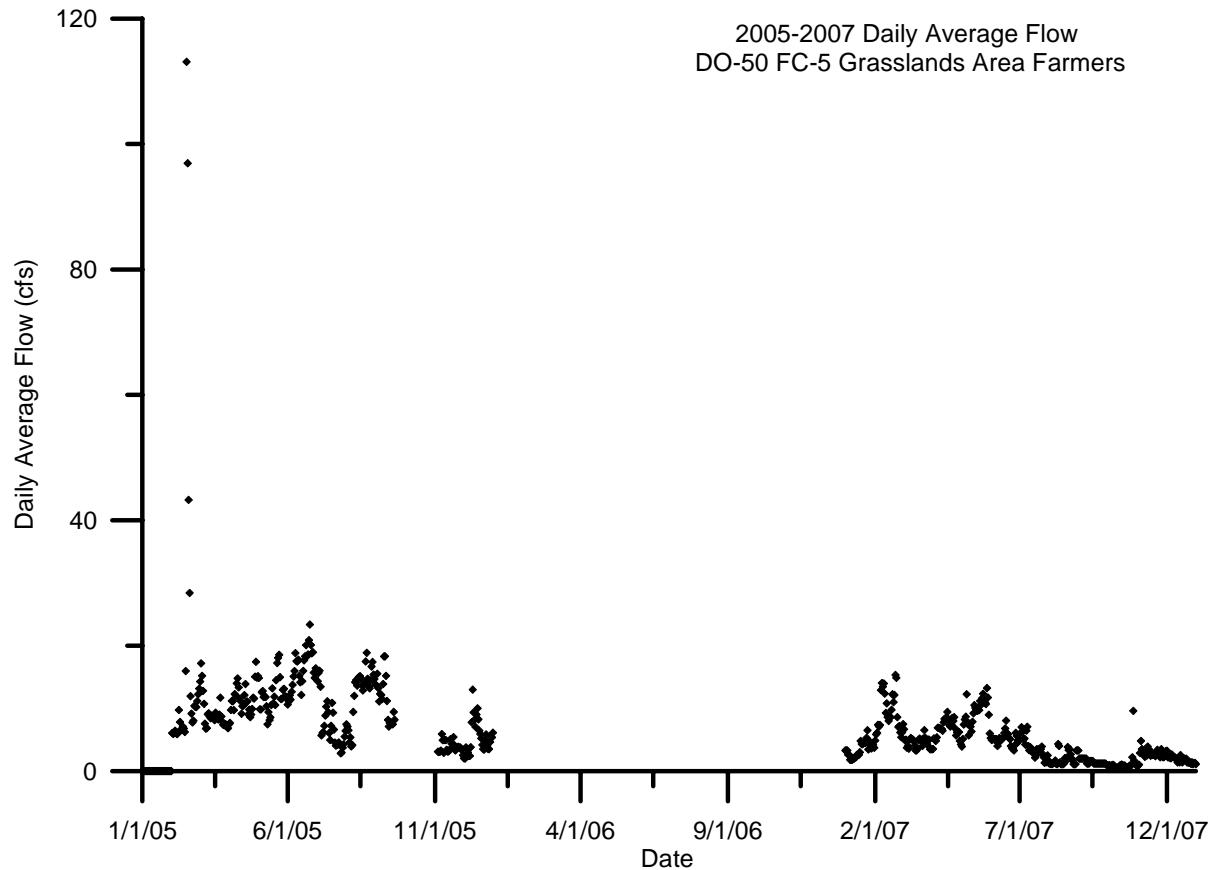


Figure 87: 2005 through 2007 flow plots for DO-53 Salt Slough at Wolfsen Road

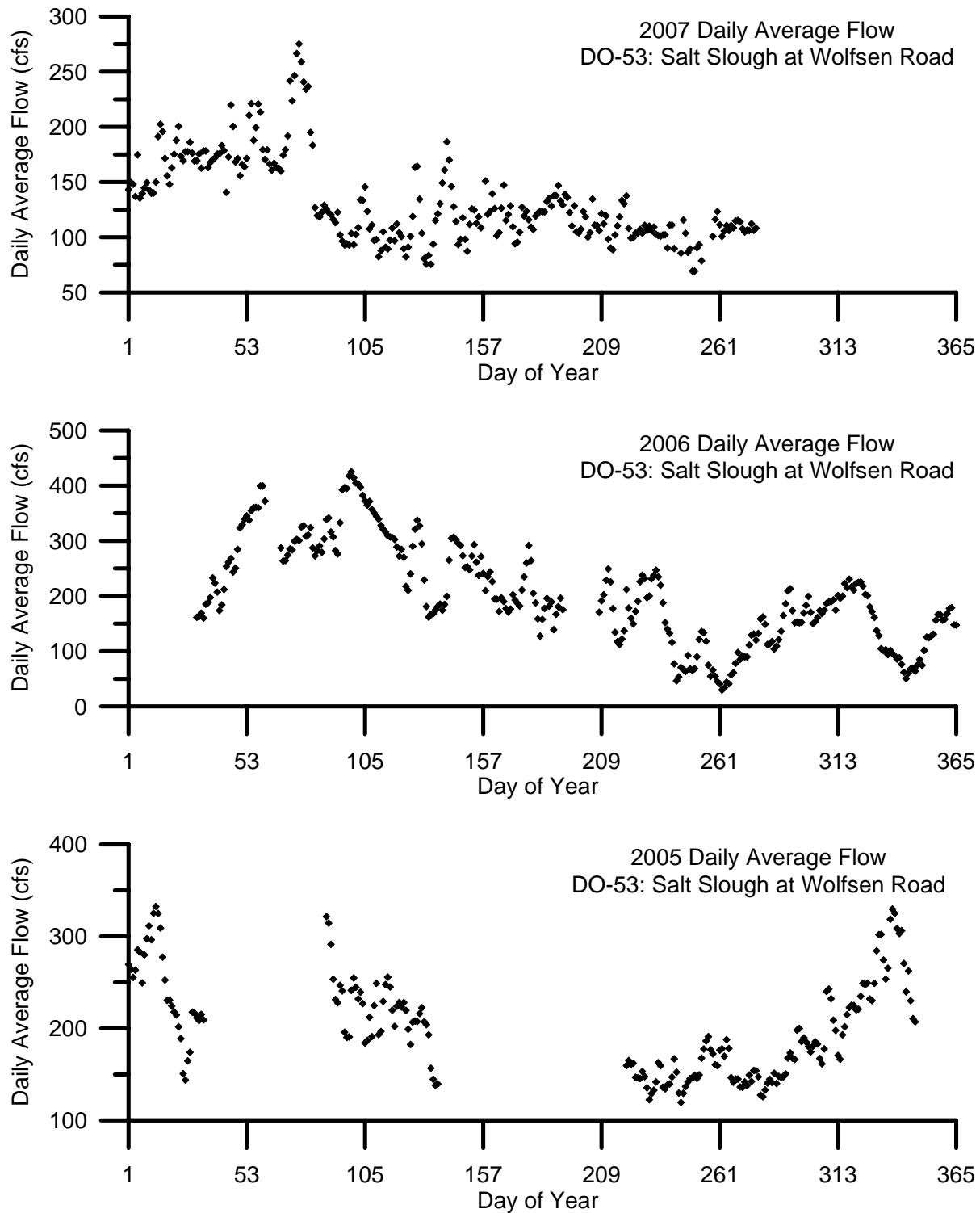


Figure 88: 2005 through 2007 flow plot for DO-53 Salt Slough at Wolfsen Road

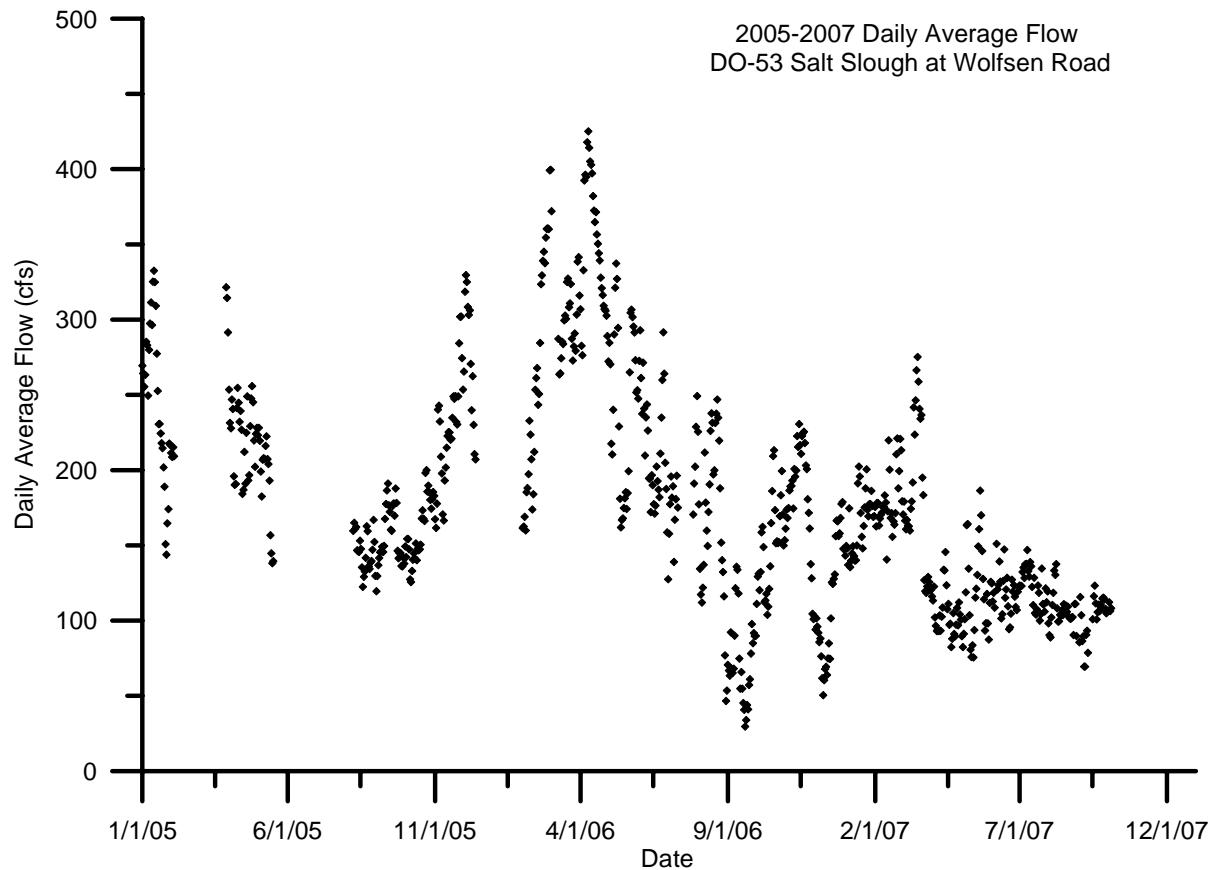


Figure 89: 2005 through 2007 flow plots for DO-57 Ramona Lake at Levee

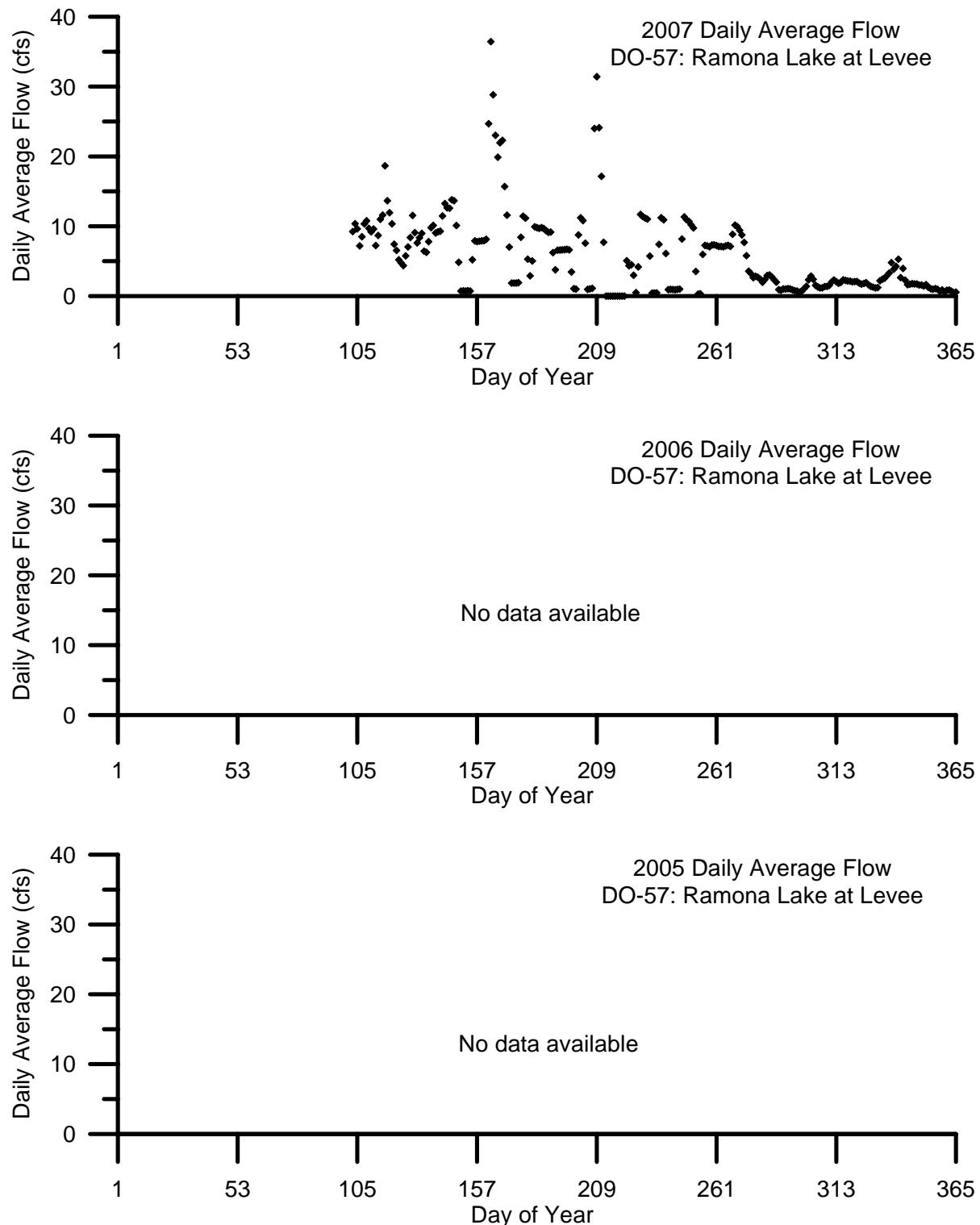


Figure 90: 2005 through 2007 flow plot for DO-57 Ramona Lake at Levee

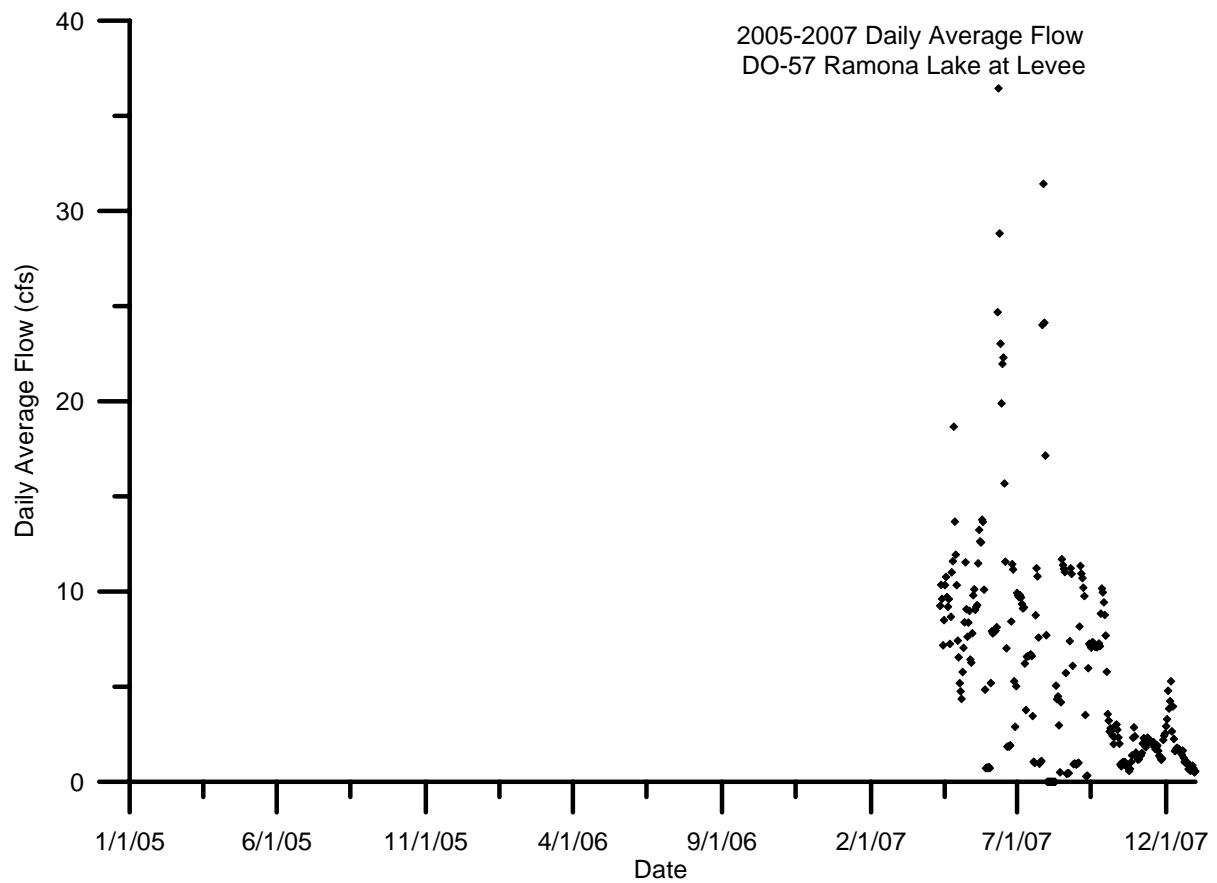


Figure 91: 2005 through 2007 flow plots for DO-59 SJR Laird Park

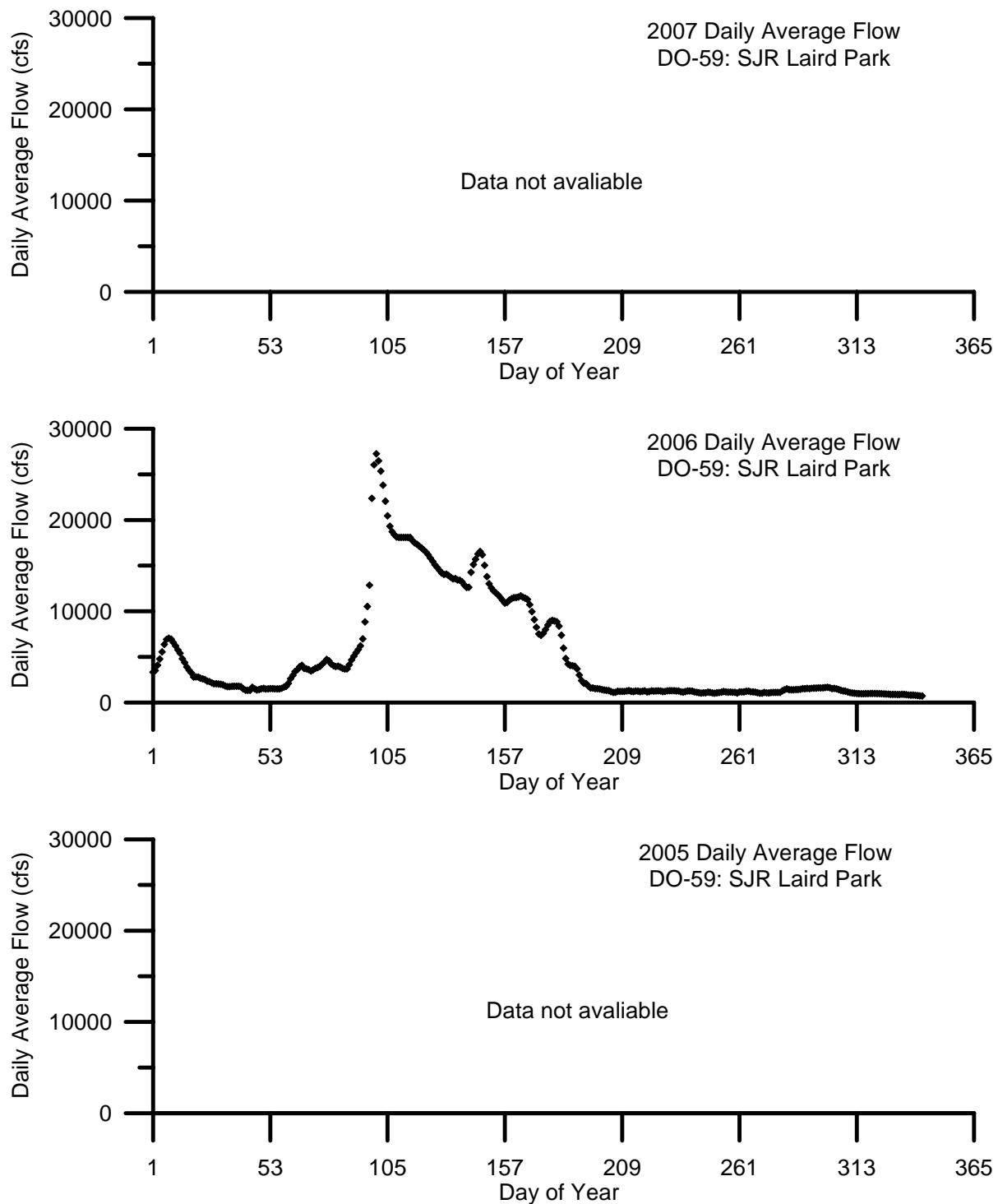


Figure 92: 2005 through 2007 flow plot for DO-59 SJR Laird Park

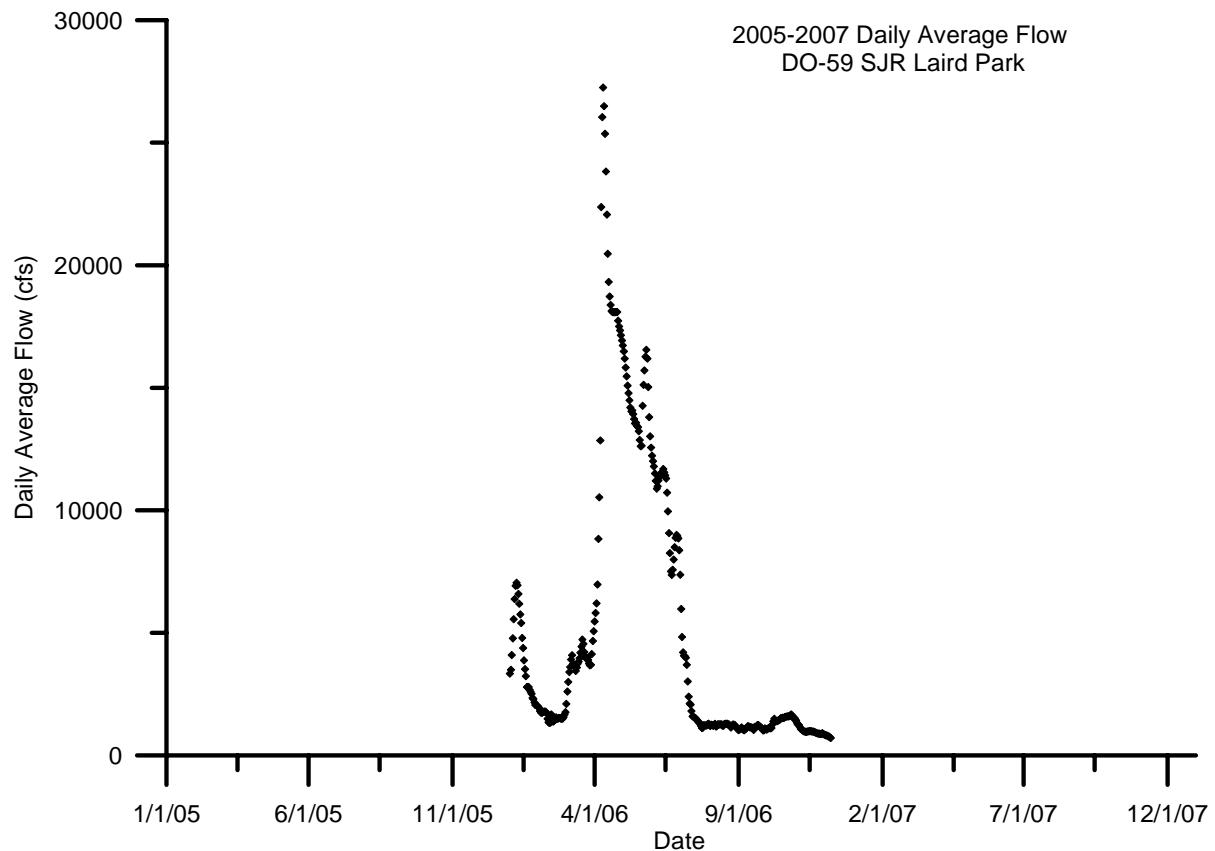


Figure 93: 2005 through 2007 flow plots for DO-60 Moffit 1 South

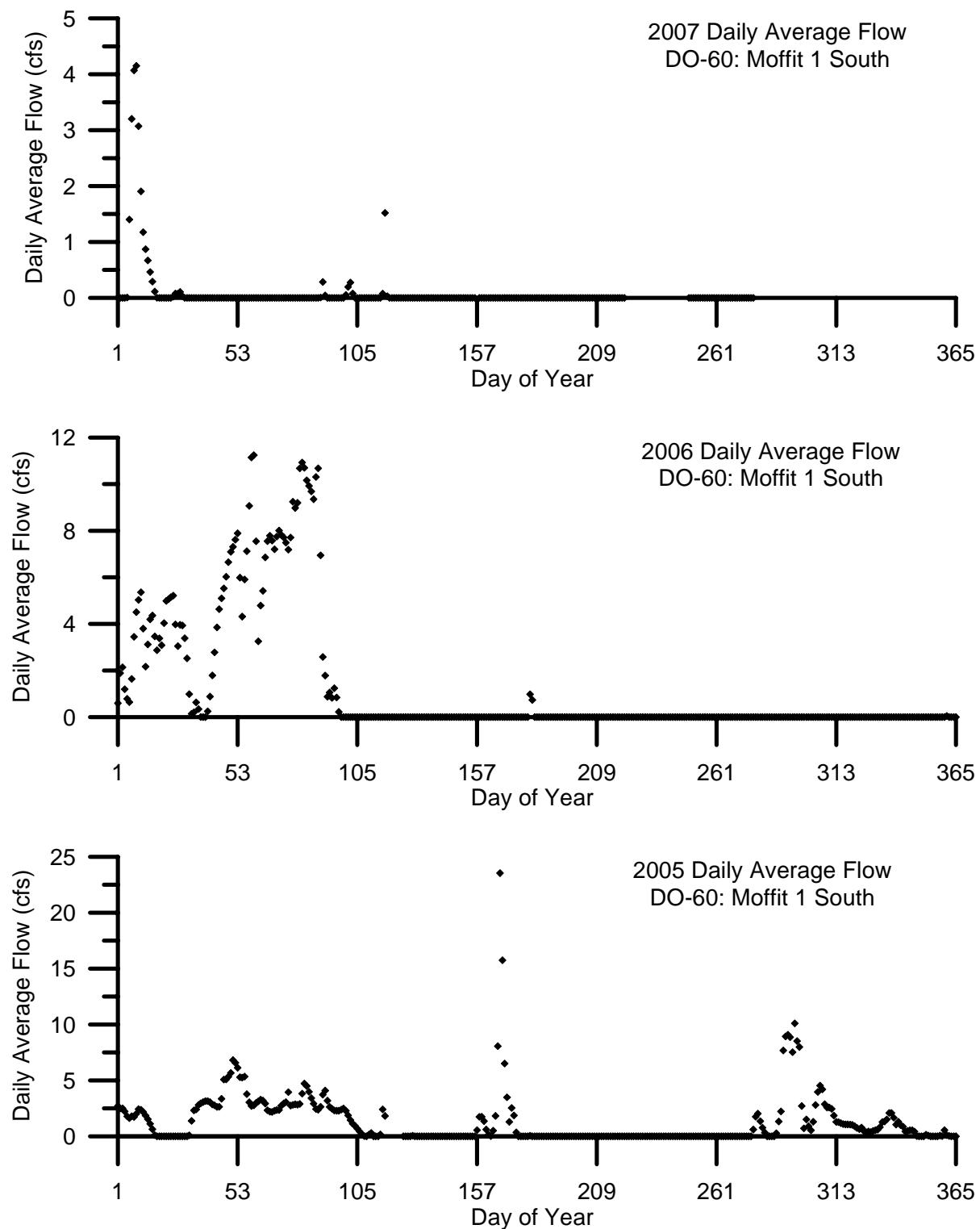


Figure 94: 2005 through 2007 flow plot for DO-60 Moffit 1 South

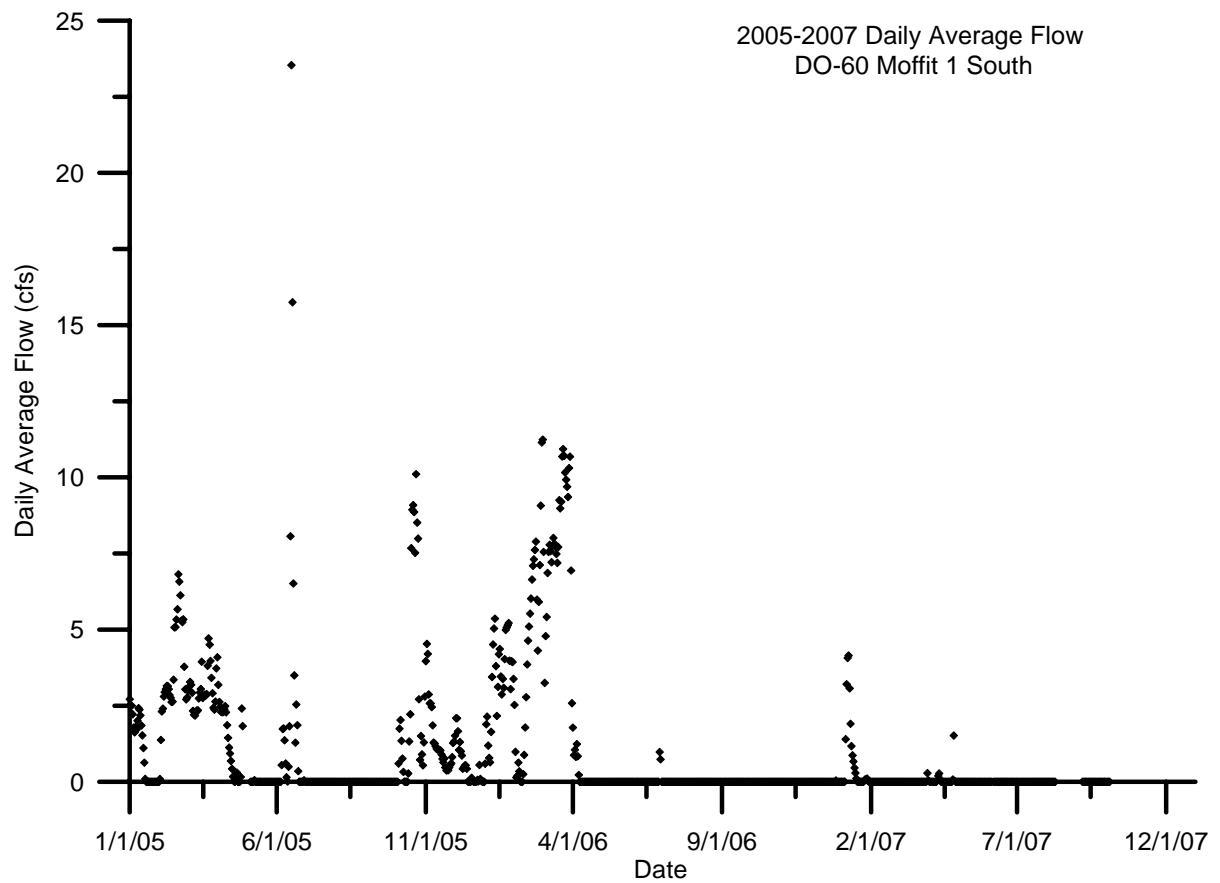


Figure 95: 2005 through 2007 flow plots for DO-61 Deadmans Slough

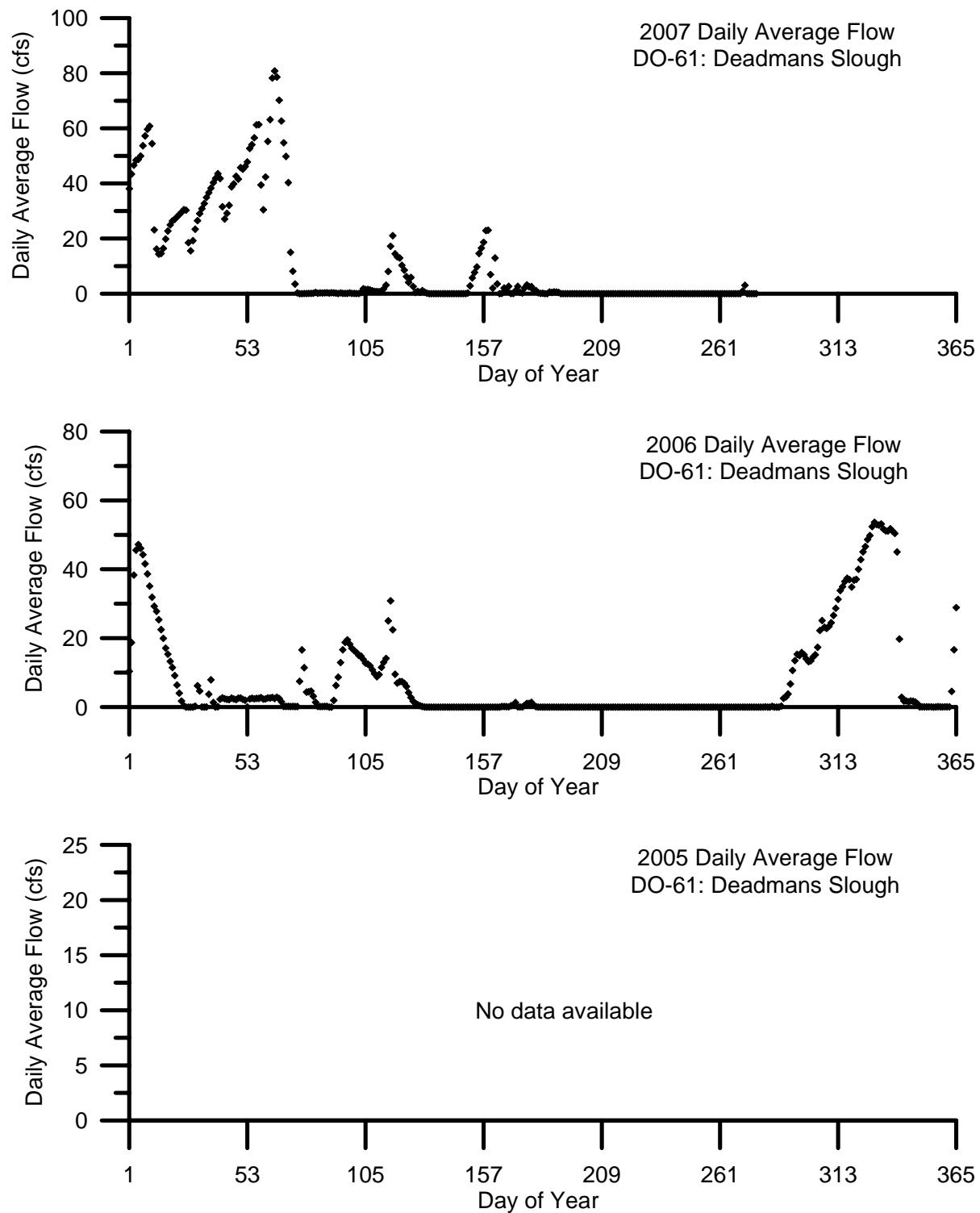


Figure 96: 2005 through 2007 flow plot for DO-61 Deadmans Slough

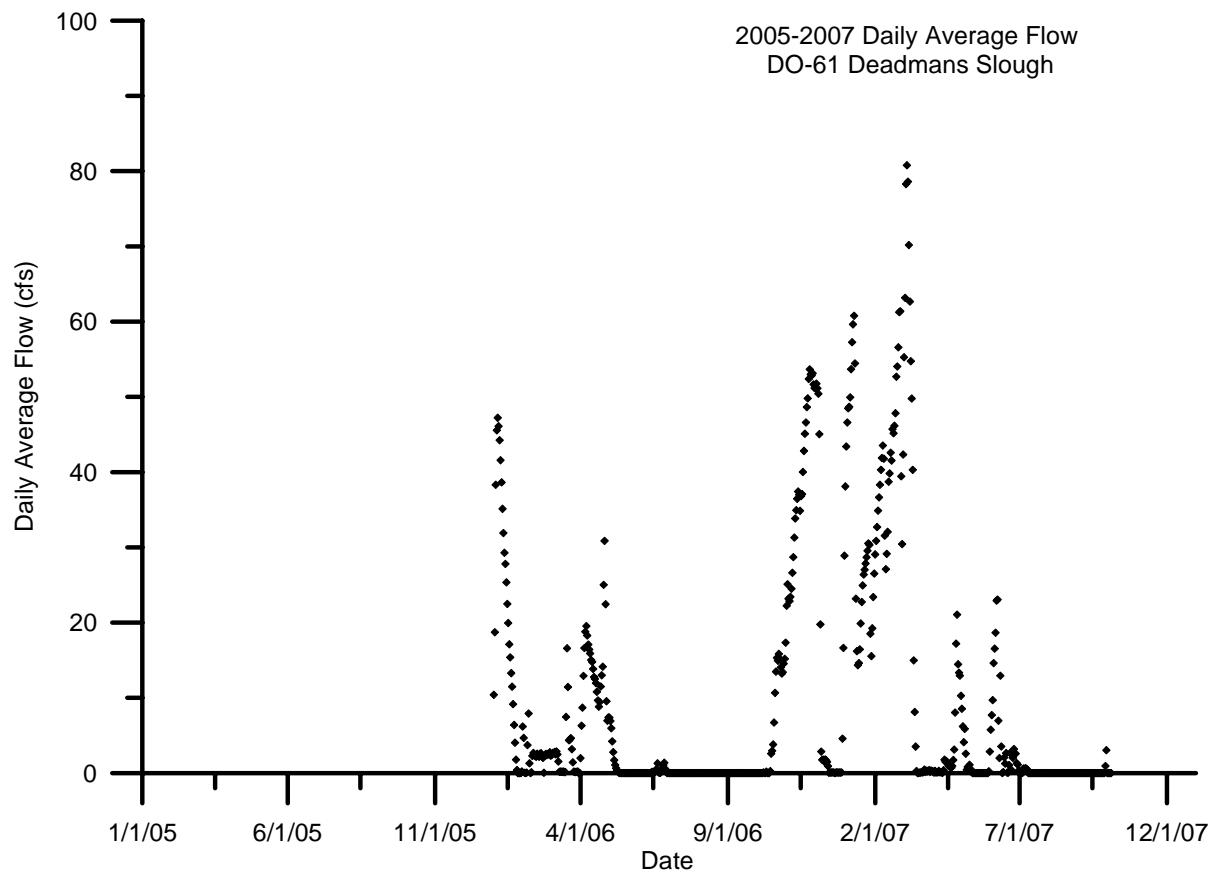


Figure 97: 2005 through 2007 flow plots for DO-62 Mallard Slough

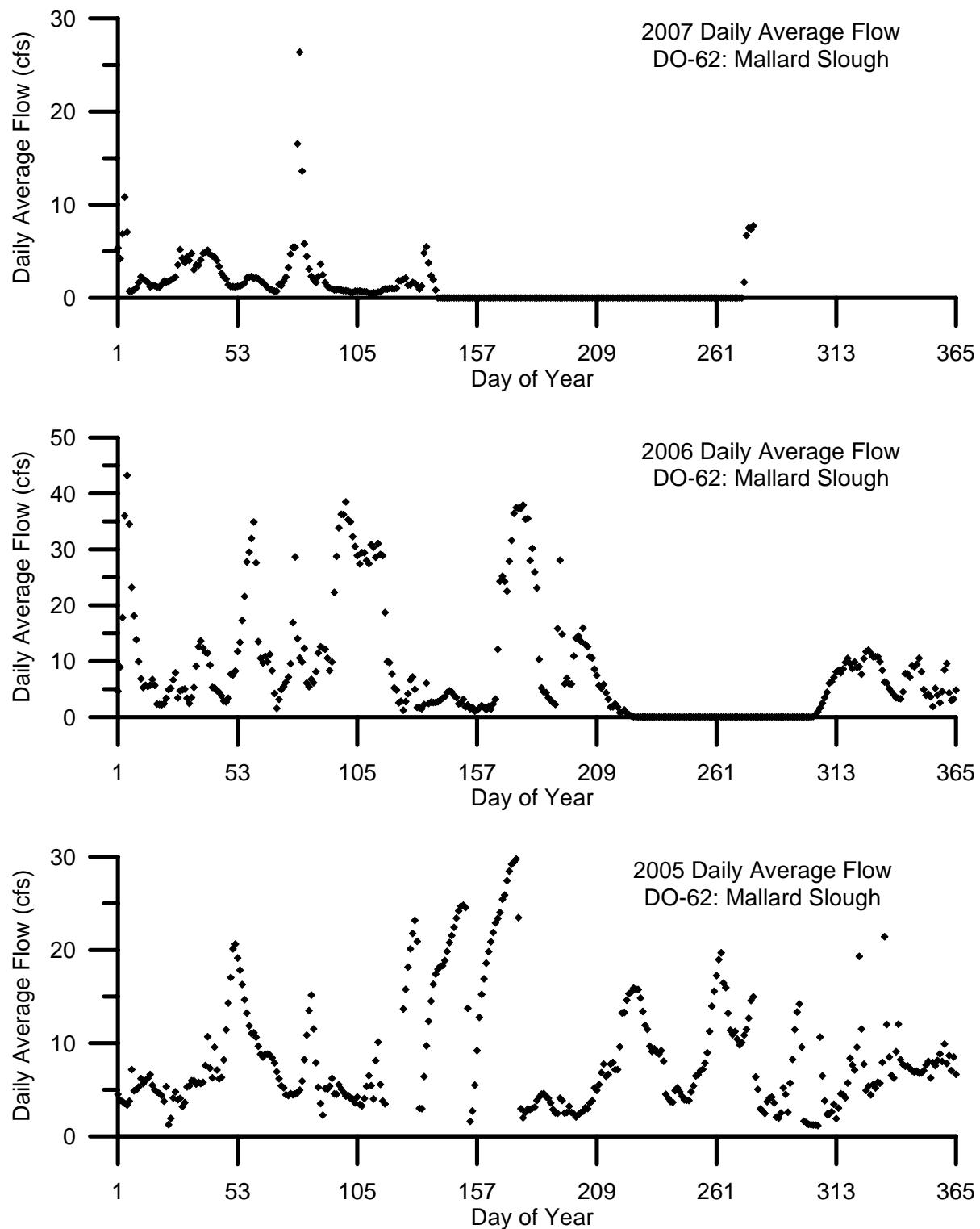


Figure 98: 2005 through 2007 flow plot for DO-62 Mallard Slough

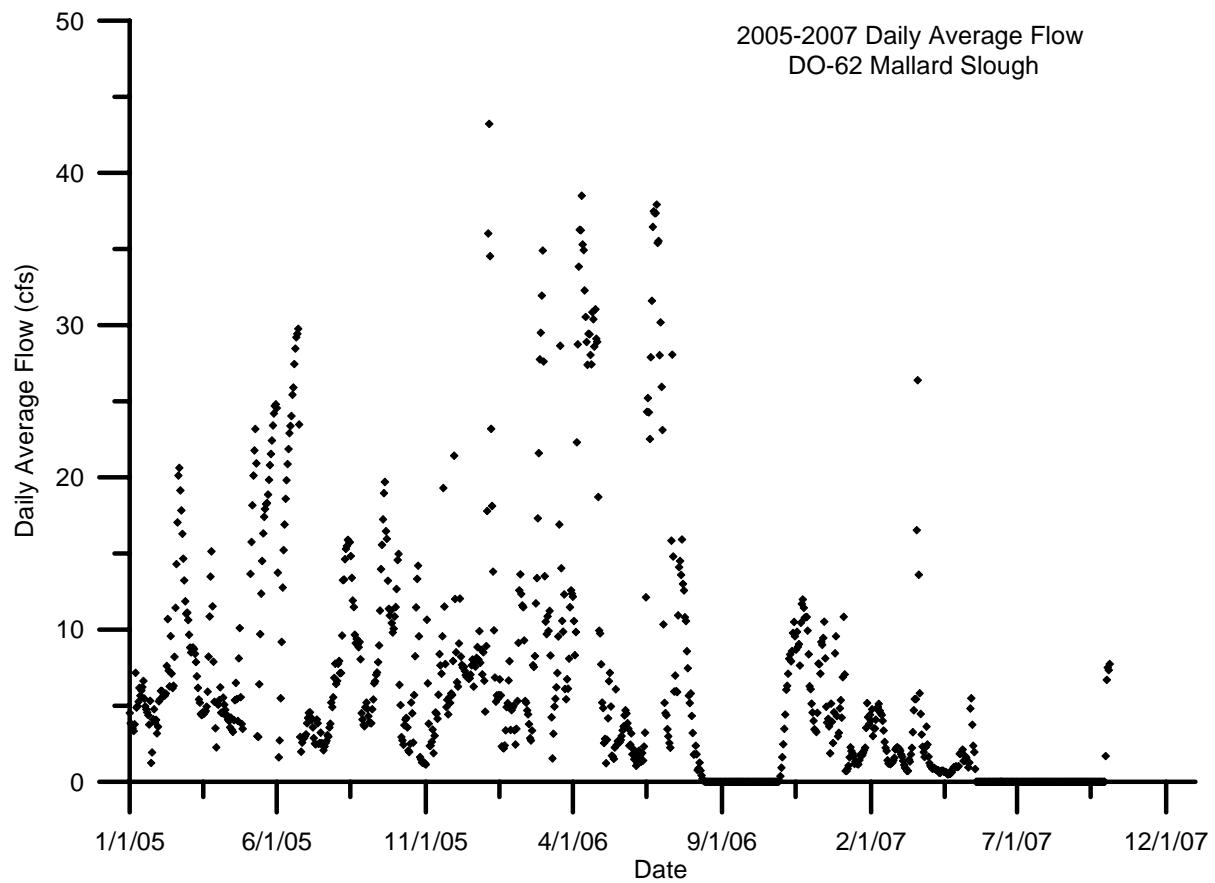


Figure 99: 2005 through 2007 flow plots for DO-63 Inlet C Canal

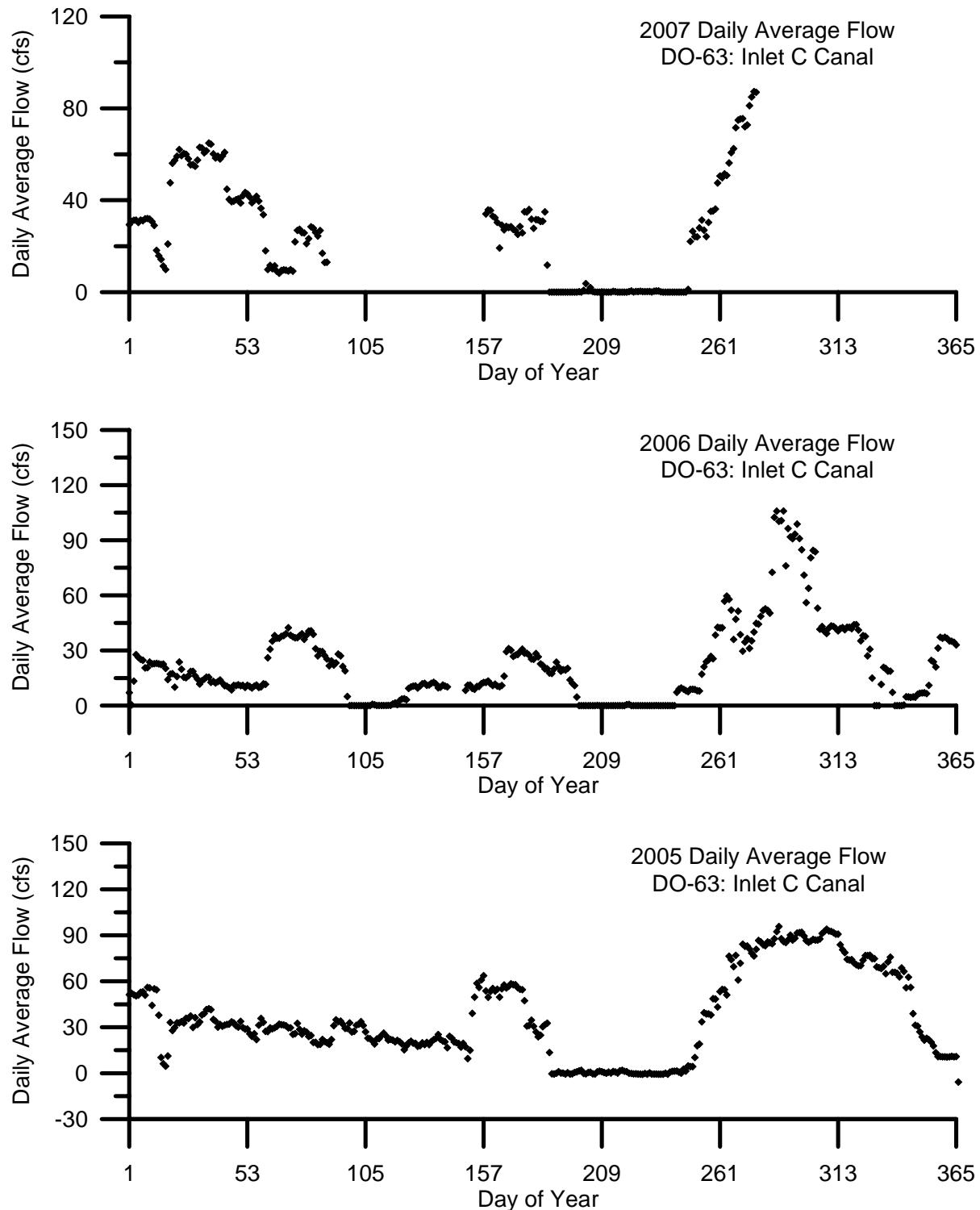


Figure 100: 2005 through 2007 flow plot for DO-63 Inlet C Canal

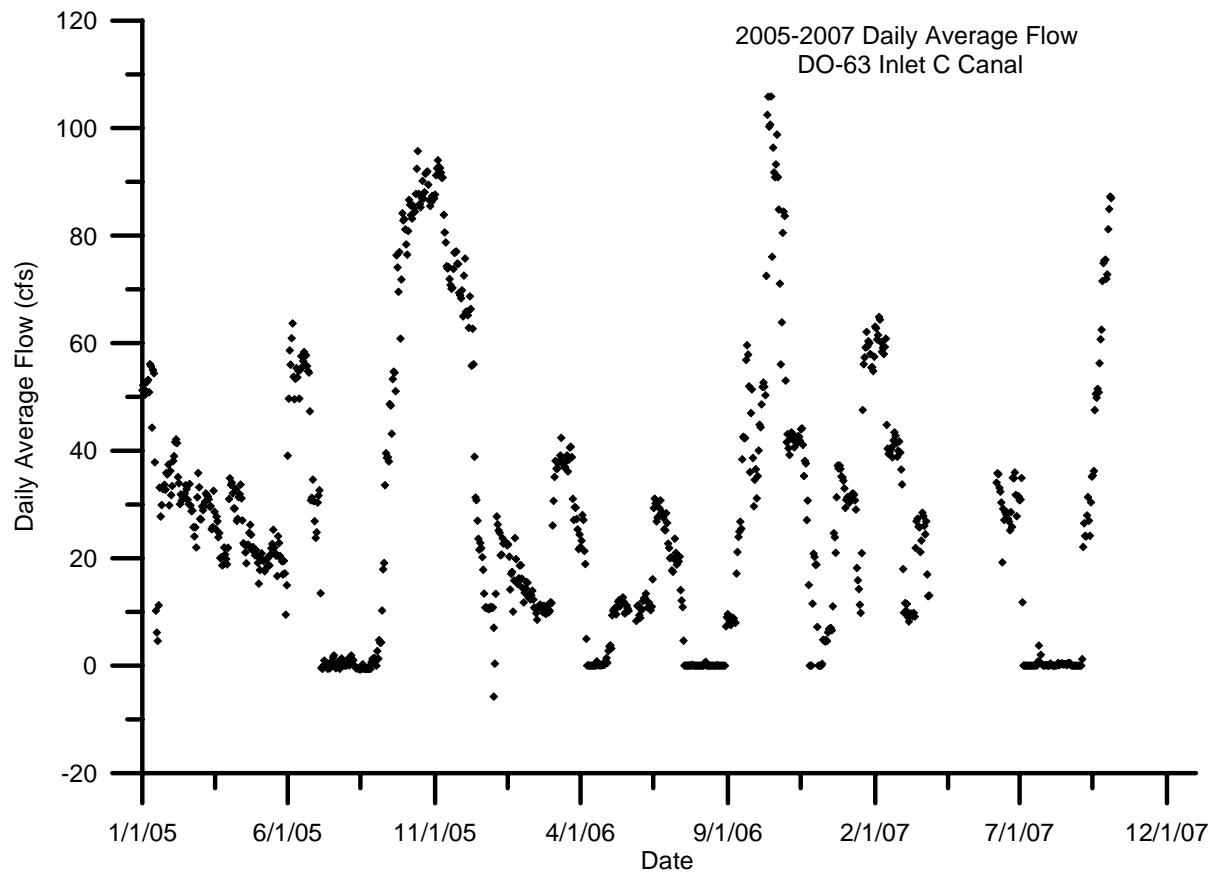


Figure 101: 2005 through 2007 flow plots for DO-64 Moran Drain

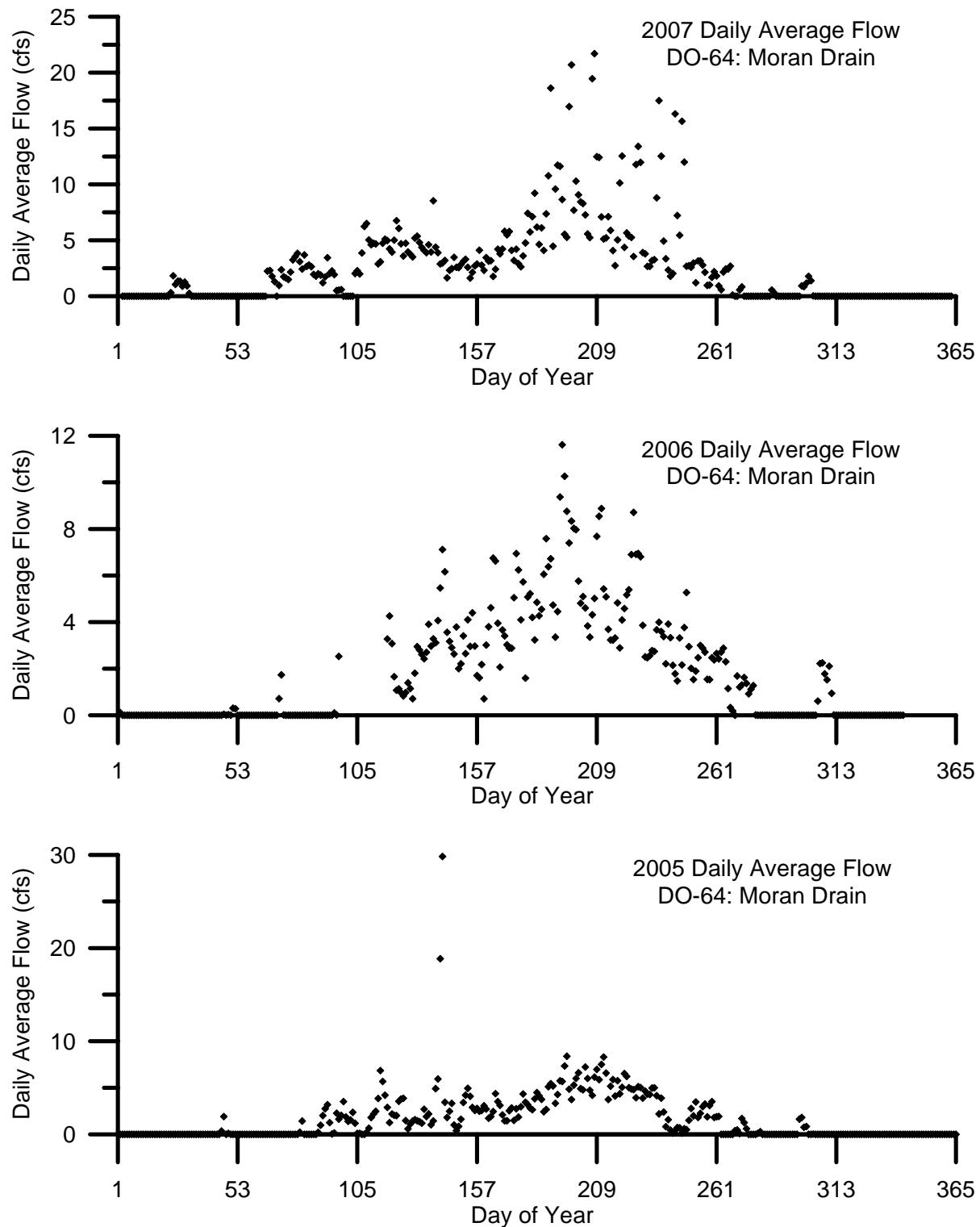


Figure 102: 2005 through 2007 flow plot for DO-64 Moran Drain

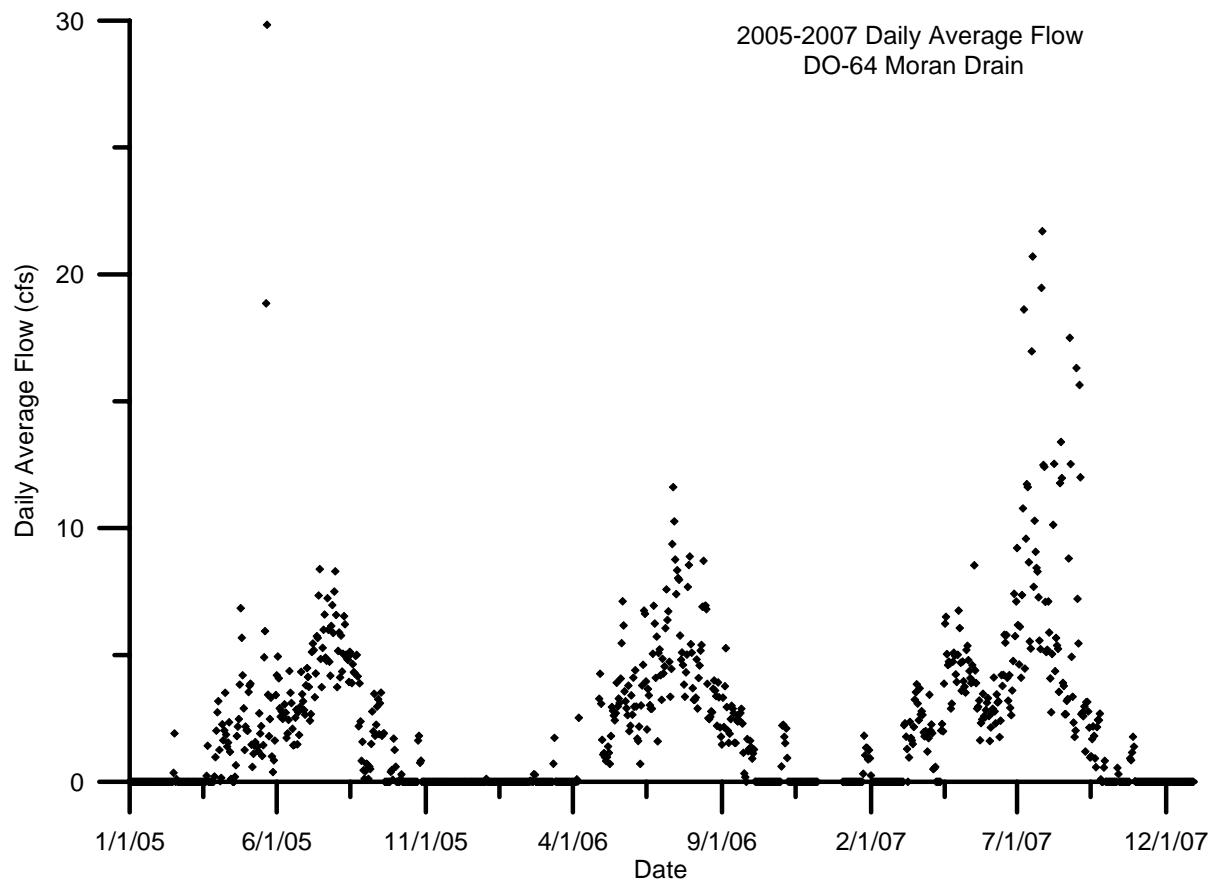


Figure 103: 2005 through 2007 flow plots for DO-65 Spanish Drain

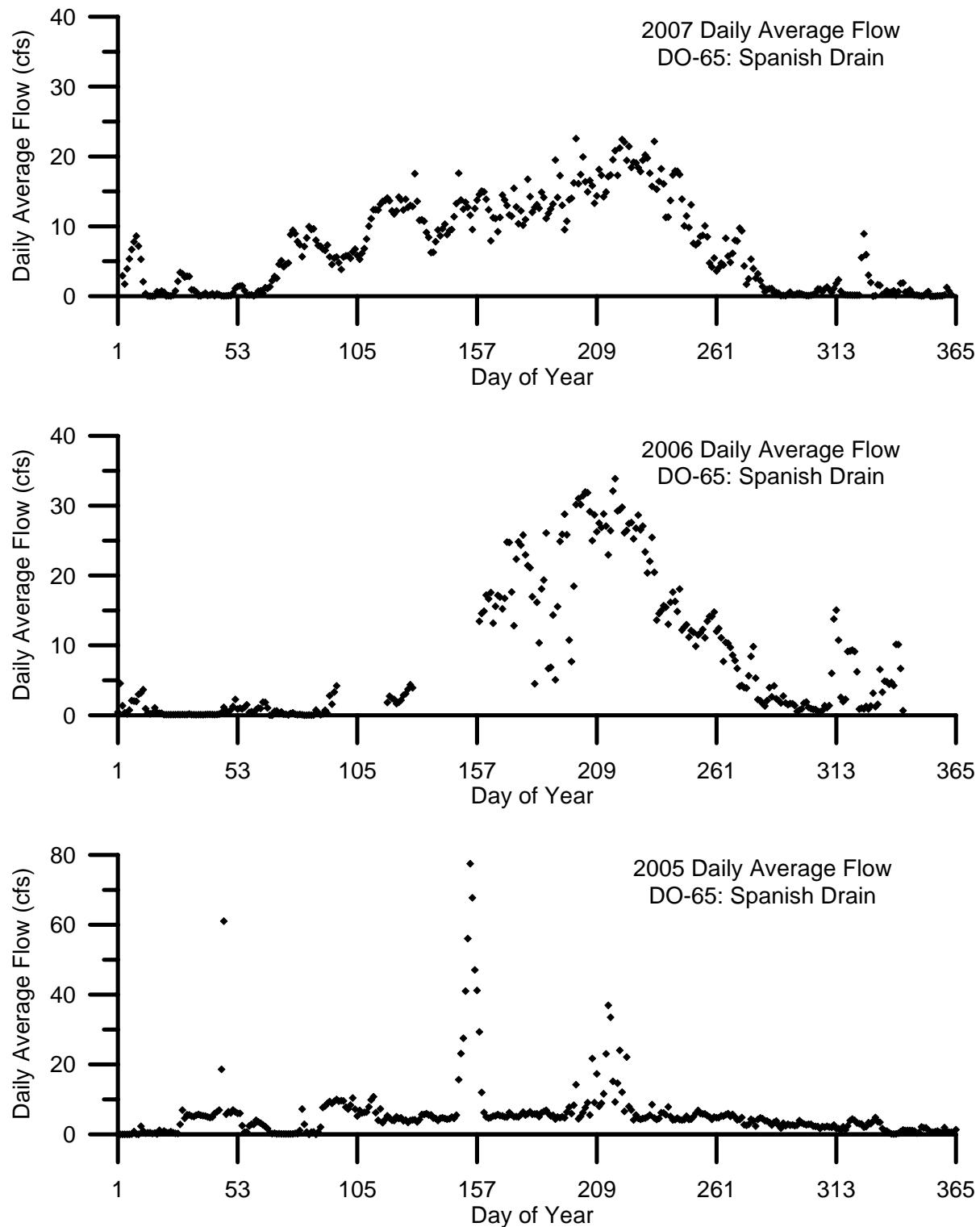


Figure 104: 2005 through 2007 flow plot for DO-65 Spanish Drain

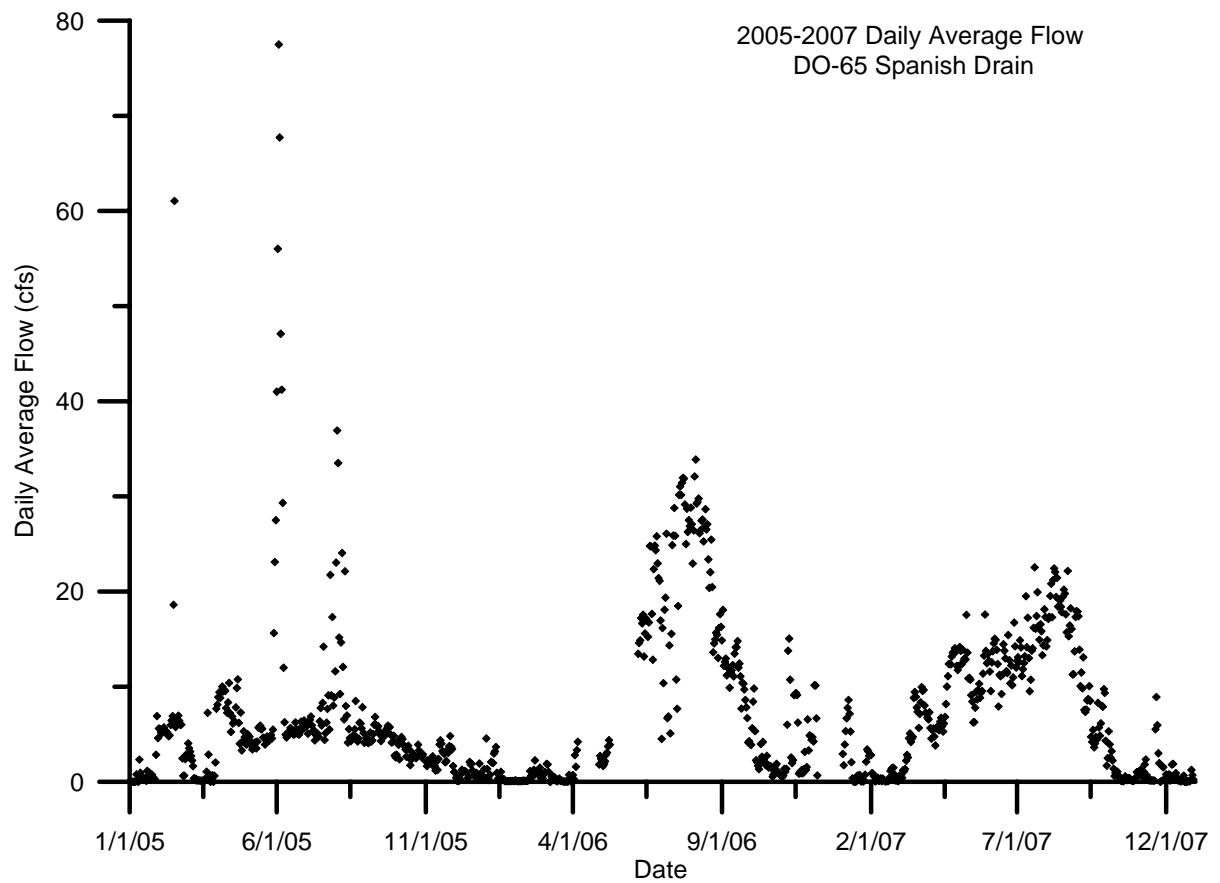


Figure 105: 2005 through 2007 flow plots for DO-68 S-Lake Drain

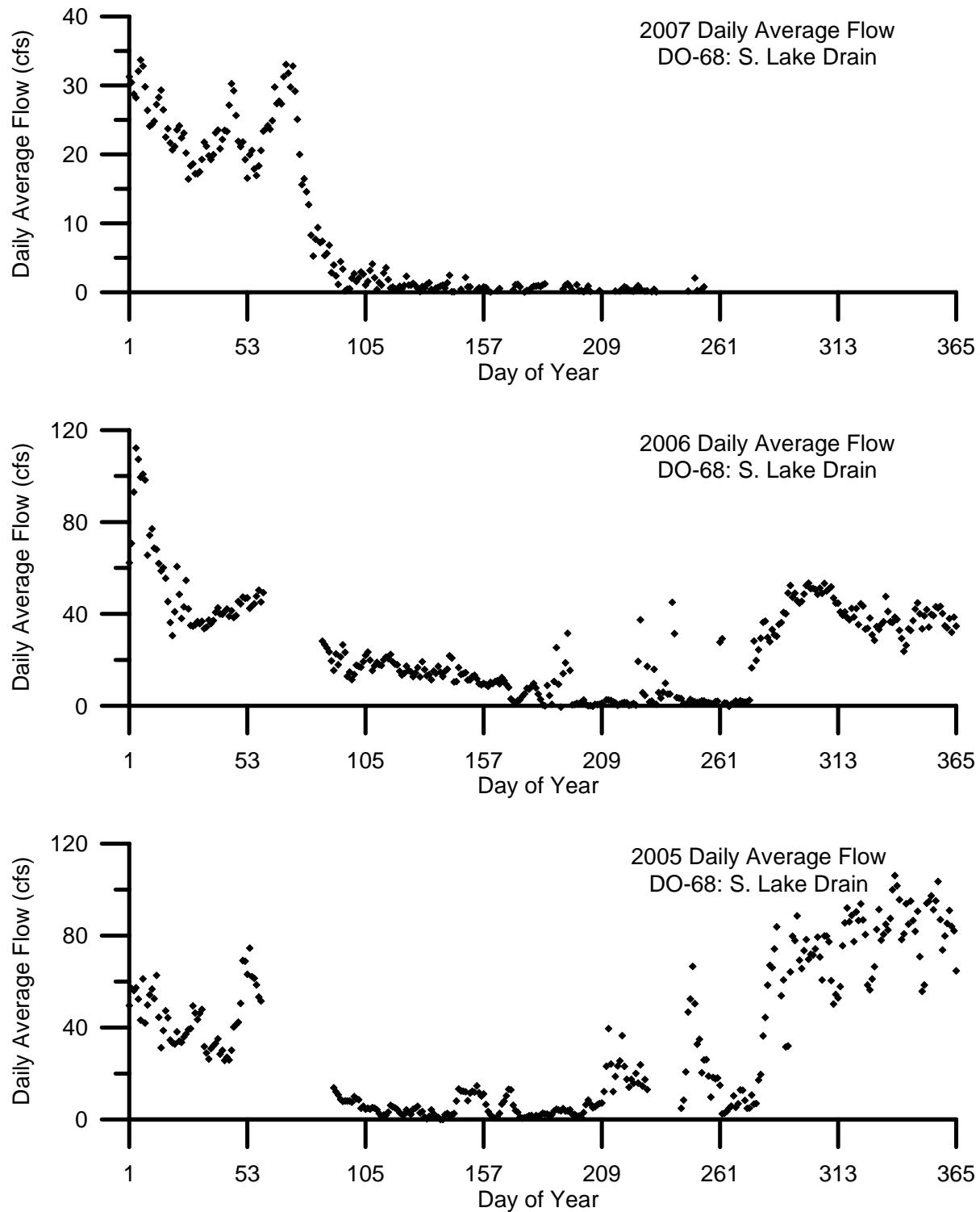


Figure 106: 2005 through 2007 flow plot for DO-68 S-Lake Drain

